Author(s): Donna Skyrme

Title: A comparison of visual scan patterns for an elite judge, elite coach and novice judge in dressage

Date: September 2013

Originally published as: University of Chester MSc dissertation

Example citation: Skyrme, D. (2013). *A comparison of visual scan patterns for an elite judge, elite coach and novice judge in dressage*. (Unpublished master's thesis). University of Chester, United Kingdom.

Version of item: Submitted version

Available at: http://hdl.handle.net/10034/320306

A Dissertation submitted in partial fulfilment of the requirements of the University of Chester for the degree of M.Sc. Sports Sciences (named pathway Psychology)

September, 2013

Word Count: 14,802

No portion of the work referred to in this Dissertation has been submitted in support of an application for another degree or qualification of this, or any other University or institute of learning.

The project was supervised by a member of academic staff, but is essentially the work of the author.

Signed …………D Skyrme……………………………………

Date ………………23.09.2013………………………………

Abstract:

Visual search patterns have often been studied in the sport domain with comparisons between expert and novice performers. Less research has been done comparing the visual search patterns of judges and in particular comparing the search patterns between elite judges and coaches.

This study examines the visual search patterns of an elite judge, an elite coach and a novice judge over three dressage tests. The participants watched and judged three dressage tests lasting approximately five minutes each whilst wearing the ASL 501eye tracking device which recorded their eye gaze onto a video camera.

Frame by frame analysis was completed for each participant on the eye tracking data and the number of fixations, the duration of the fixations and the location of the fixations were recorded.

Analysis of the results found the two experts had similarities between their visual search patterns and as expected the novice judge had a greater number of fixations compared to the expert judge during two of the dressage tests. However, the expert judge had a lower duration time fixating than was expected compared to the novice judge and the expert coach.

It is possible that the expert judge is able to process the information to make the decision more effectively. Therefore, more research is needed to explore the similarities of varying levels of expertise within sport to help develop and recognise what novice and intermediate judges or coaches need to improve to reach an elite standard and also to see if there are similarities or differences between elite performers, coaches and judges.

Acknowledgements:

I would like to acknowledge the following people who have supported me throughout my postgraduate research.

Firstly, I would like to acknowledge and thank my supervisor Dr Moira Lafferty for the continuous support, encouragement and feedback given to me to be able to continue and finalise this research project.

Secondly, I would like to acknowledge and thank the three participants that took the time to participate within my research project and provided me with the results essential for the completion of my research.

Finally, I would like to acknowledge all those who have supported me through the entire development of this research project.

List of Contents:

List of Figures

List of Tables

1. Introduction:

Our senses are a natural component in our day to day lives and a pivotal element in the world of sport. Vision is a sense that plays a fundamental role in our daily lives and is known as one of the most dominant, important and frequently used of the five senses (Bjorklund, 2010 & Langhout, 2012). The importance of the visual sense is represented by the portion of the brain that is devoted to interpreting sight, which is larger than all of the other portions of the brain devoted to the other senses (Bjorklund, 2010).

As humans we use visual search frequently from looking for someone in a crowd to looking for a set of keys. The environment contains an abundance of visual information for an individual to receive, which is where vision plays a vital role for an athlete to be able to select the relevant information needed (Moran, Byrne & McGlade, 2002 & Mecheri, Gillet, Thouvarecq & Leroy, 2011). This information is crucial to an athlete when adapting spatial positioning, modifying movement and optimisation of balance (Mecheri et al, 2011). Therefore, a form of selective processing is essential to analyse and make sense of the information that is perceptually obtained (Moran, Byrne, & McGlade, 2002). For example this selective processing could be crucial to an athlete when they need to quickly adapt their position when receiving visual cues from an opponent's stroke motion. This selective processing requires visual filtering and is accomplished through eye movements that convey a sequence of images of required stimuli to the fovea (Kowler, 1999). These images are then maintained there by the attentional system for as long as the images are required (Kowler, 1999).

The visual system is therefore one of the most used systems for athletes, coaches and judges to obtain information from the environment and it has been established that vision is the most precise perceptual system to obtain information important for the control of motor skills (Magill, 1980; McLeod, 1991).

Therefore, through studying individual's eye movements researchers are able to investigate the relationship between visual fixation (i.e. looking) and attention (i.e. seeing) (Moran et al., 2002). Researching eye movements of elite athletes allows us to begin to establish what and where these elite athletes are looking at (Williams, Davids, & Williams, 1999). For example a netball player needs to be able to detect and interpret the light information that reflects from the surface of the netball to be able to execute a common task such as a two handed catch (Williams et al., 1999). Therefore, when the netball player is performing this basic skill they need precise information that allows them to locate the ball in the air ('where' information) at a specific moment in time ('when' information) (Williams et al., 1999).

Research by Cereatti, Casella, Manganelli and Pesce (2009) suggests that the development of visual attention leads to cognitive expertise, which is a key factor within sport that encourages and can enhance effects of physical exercise upon attentional performance. For example, having the expertise to encode the visual scene and environment around you can lead to what is known as the "no-look" pass in basketball, where players can throw the ball into an empty space or to where they are not looking aware that the receiver will be there to receive the pass (Memmert, Simons, & Grimme, 2009).

Researchers have studied expertise within a broad spectrum of sports including football, basketball, golf, ice hockey and tennis (Al-Abood, Bennett, Hernandez, Ashford, & Davids, 2002; Fairchild, Johnson, Babcock, & Pelz, 2001; Goulet, Bard, & Fleury, 1989; Hernandez et al; 2006; Martell & Vickers, 2004; McPherson, 2000; Panchuk & Vickers, 2006; Vaeyens, Lenoir, Williams, Mazyn, & Philippaerts, 2007). Through this research experts are shown to have supplementary effective visual search strategies and attend more to relevant information than irrelevant information from the environment (Ste-

Marie, 2003). For example, Panchuck and Vickers (2006) found goaltenders in ice hockey mainly fixated on the puck and stick allowing them to read the orientation of the shot, therefore, they are focusing on the relevant information and not the irrelevant information within the environment.

In reviews by Abernethy (2001), Williams (2001), Starkes, Helsen, and Jack (2001) and Tenenbaum and Bar-Eli (1993, 1995), expert athletes are shown not only to have enhanced visual search strategies and also superior recognition and recall of structured information, better anticipation skills and superior knowledge of interrelationships amongst relevant variables.

Similar research has been conducted with coaches (e.g., Cote, Salmela, Trudel, Baria, & Russel, 1995; Salmela, Draper, & Laplante, 1993) and on instructors (e.g., Ilmwold, & Hoffman, 1983), however, this research is limited and sport evaluators i.e. judges still remain as an understudied population within sport psychology.

Another population that plays an important role in sports are referees as they ensure that the rules are followed and their decisions can significantly impact the development and outcome of a game. For example, the 1990 world cup in football was won by a German player scoring the only penalty awarded by the referee in the match (Plessner & Betsch, 2001). This role is significant as correct or incorrect decisions may become critical in who wins or loses an event.

The expert roles of a judge and a referee are similar to those of expert athletes and follow the same logic that decisions are made based on perceptual information and knowledge retrieved from the relevant information within a moving display (Ste-Marie, 2003 & Williams & Grant, 1999). Therefore, knowledge of the differences in novice and expert athletes and judges/referees' visual search patterns can assist in the development of training strategies to help accelerate the journey from novice to expert (Williams, Davids & Williams, 1999).

Athletes and judges portray apparent similarities that include searching for the relevant information and cues. Both groups have to take in and attend from a dynamic display and then make decisions based on perceptual information and also stored factual and experiential knowledge (Williams, Davids & Williams, 1999). Whilst the process is similar, differences also exist between the two roles. Athletes are more involved in the perception-action link of their performance whereas judges are involved more in the perception and decision making aspects of the performance (Williams, Davids & Williams, 1999).

Research previously conducted with judges and coaches has mainly focused upon comparing experienced judges/coaches to novice judges/coaches (Bard, Fleury, Carrière, & Hallé, 1980; Hernández, Romero, Vaillo, & Del Campo, 2006; Moreno, Reina, Luis, & Sabido; 2002; Page, Lafferty, & Wheeler, 2007 & Ste-Marie, 1998). Results generally showed similar trends to when elite athletes have been compared to novice athletes, suggesting that elite level judges and coaches have similar visual search patterns and enhanced selective attention process.

However, there has been little research done comparing experienced judges and coaches within a sport. Therefore, this current research project is designed to investigate if there are any significant differences or similarities between experienced dressage judges and coaches visual search patterns when judging a dressage test. Page, Lafferty and Wheeler (2007) found that judges and coaches had similar search patterns when assessing a gymnastics performance and highlighted the implications for the development of perceptual training.

If the current research finds similar results to that of Page et al (2007) this could have significant implications on the development of training and coaching within the sport of dressage. For example, judges could be trained to develop their eye patterns to that of an elite judge and also equestrian athletes can be coached to know where and what a judge is looking at when they are judging in a competition. This could therefore be useful for the development of elite performance for judges, coaches and athletes within the sport of dressage.

1.2. Aims and Objectives:

The aim of this study is to compare the visual scan patterns of an elite coach and novice judge against the visual scan pattern of an elite judge. To see if there is a significant difference between the two or if their visual scan patterns have similarities.

1.3. Hypotheses:

There are four hypotheses for this study:

1. The expert judge will produce fewer fixations compared to the novice judge and expert coach during the dressage tests.
2. The expert judge will produce longer durations of fixations compared to the novice judge and expert coach during the dressage tests.
3. The location of fixations for the expert judge will be different compared to the novice judge and expert coach.
4. The expert coach will show similarities in the visual scan pattern compared to the expert judge.

2. Review of Literature:

2.1. Vision:

It is well known that when an individual is doing an activity such as reading and watching television a series of eye movements are made (called saccades) which are separated by fixations (Rayner, 1998). These eye fixations can typically last between 200-300 ms and it is during this time that new information is acquired by the processing system and the mental representation of what the reading material, or visual display means is constructed (Rayner, Liversedge, White & Vergilino-Perez, 2003). These eye movements are critical as they mediate the complex sequence of cognitive processes involved in extracting the required visual information from the environment (i.e. the text when reading, or from a visual display) and secondly, by interpreting that information (Rayner et al., 2003).

The velocity and duration of a saccade is influenced by the distance covered; a 2° saccade takes 30 ms which is typical of reading, whereas the distance of a 5° saccade can take 40-50 ms which is typical of scene perception (Abrams, Meyer & Kornblum, 1989; Rayner, 1998). Research conducted by Rayner (1998) found that these saccadic eye movements had an estimated velocity of 8.72 rad. s^{-1} and the velocities of these rapid eye movements can reach as high as 500° per second. For example, in sport an athlete uses rapid eye movements to scan quickly from one player to another or from the ball to the target i.e. the net where they are shooting (Williams et al., 1999). These rapid eye movements therefore allow an athlete to transfer from one fixation point to another for them to gain the relevant information to perform the next tackle, movement, dodge or shot.

Sensitivity to visual input can be reduced during eye movements due to the fast movements of images across the retina (Rayner, 1998). This phenomenon has been identified as a saccadic suppression and has been the topic of debate since identified by Matin in 1974 (Rayner, 1998). This can be explained by either central or peripheral limitations (Williams et al., 1999). In theory due to the decrease in information processing during saccadic eye movements it has been argued that a search pattern containing fewer fixations for a longer duration with less eye movements is more effective (Williams et al., 1999).

During a saccade new information cannot be obtained due to the rapid eye movement across the stable visual stimulus that causes only a blur to be perceived for an image (Rayner, 1998). However, the information available before and after a saccade causes a masking effect, which eliminates any perception of blurring (Irwin, 1998; Rayner, 2009). Even though this new information is neither obtained nor encoded cognitive processing can continue during a saccade therefore creating a stream of information (Rayner, 2009).

During the intervals between the saccades researchers are able to analyse the smooth pursuit eye movements as this provides them with a sustained line of sight on the selected or required targets (Moran et al., 2002). Analysing the smooth pursuit is important because if an object or the head positioning is displaced from the retina then the perceiver is able to compensate with the smooth pursuit eye movement (Moran et al., 2002).

In summary, vision consists of eye movements known as saccades, which are separated by fixations. Fixations are known to last between 200-300 ms and during this time new information is acquired by the processing system. These eye movements are a critical part of the cognitive process by being involved in extracting the relevant information from the environment. The saccade eye movements in scene perception can last 40-50 ms. This therefore, allows an athlete to quickly transfer from one fixation location to another to be able to gain the required information.

2.2. Guided Search:

Specific cue usage is applied to specific sources of information in the visual environment by an individual to guide their action(s) (Williams, Janelle, & Davids, 2004). These specific cues are referred to in previous research as being unique colours or unique orientations to guide saccades to the acquired target (Chelazzi, Duncan, Miller, & Desimone, 1998; Motter & Belky, 1998; Wolfe, Cave, & Franzel, 1989). For example Motter and Belky (1998) used a target colour to selectively guide the visual search through relevant stimuli in the visual field. Wolfe et al. (1989) found that targets defined either by unique colour or unique orientation were found easier and were therefore able to reduce reaction time.

Horowitz and Wolfe (1998) state that when a target has a simple visual feature such as a red or green bar then the target is easily and automatically located. However, when targets differ in their spatial arrangement individuals find the search to become more attention demanding and their reaction time can increase by 20-30 seconds per item (Horowitz & Wolfe, 1998). This is essential for an athlete because if their reaction time increases this could result in them losing the point or shot which results in losing the match. For example, in tennis if the receiver of the serve is moving their attention from the opponent’s racket to the ball to the opponent’s body this could cause them to increase their reaction time resulting in them not being able to return the ball successfully.

There are two theories of visual search to explain the reasons behind the increase in an individual's reaction time when the target differs in spatial arrangement. The first is the serial models theory which proposes that attention can only process the identity of one item at a time and once the distraction(s) have been identified and rejected a mechanism prevents that item from being revisited (Horowitz & Wolfe,1998). This would then aid the individual in completing a successful visual search for a target by decreasing the amount of stimuli in the visual display by half (Horowitz & Wolfe, 1998). The second visual search theory is the Parallel Theories which assume that identifying a specific target becomes more certain over the course of a number of trials (Horowitz & Wolfe, 1998). A response is made when either sufficient information highlights the acquired target or a distraction (Horowitz & Wolfe, 1998).

To summarise, both theories suggest that guided search can aid in reducing reaction time, however, the more stimuli that is present in the visual environment the more attention is required from the individual.

2.3. Information Processing:

For an athlete, coach and judge to make a decision they have to process the information available to them within the environment. There is a large amount of information for the brain to process in a short amount of time when interacting with the environment (Deco, Pollatos, & Zihl, 2002). The suggested mechanism that deals with this influx of information processing is attention (Deco et al., 2002). The concept of attention states that an individual can focus on certain components of the sensorial input which is processed preferentially by shifting the focus of processing information from one location to another (Deco et al., 2002). The visual system requires attention and guidance due to the eyes providing the central nervous system with more information than it can process (Wolfe, Butcher, Lee & Hyle, 2003). This mechanism is known as selective attention or focal attention (Broadbent, 1961) and is important because the visual system only allows for a small fraction of information to be received for processing (Deco et al., 2002). Bundesen (1990) states attentional selection consists of an individual making perceptual categorisations of the information in the visual field. These perceptual categorisations are selected by colour, shape or location if and when it enters the limited capacity of the short-term memory store (Bundesen, 1990). Therefore, it is important to focus attention to the most relevant and most informative areas within the visual environment (Janelle, 2002).

Research in focal attention has employed a common metaphor known as a spot light (Treisman, 1982). This suggests that a spot light of attention illuminates an area of the visual environment where certain stimuli are processed in greater detail and to a higher level (Deco et al., 2002). Therefore any information outside the spotlight will be filtered out leaving only selected information for processing. Research by Sperling and Weichselgartner (1995) revealed that the spot light (focal attention) does not continuously move along the visual environment, it fades out of one area and then increases the focal attention into another area of the environment. Research also states that the spot light can move through the visual environment with or without eye movements known as overt and covert attention (Deco et al., 2002).

Pre-attentive processing is used to guide the deployment of attention and to direct attention to the desired locations of interest within the visual field (Wolfe, 2002). In this process there are two ways that can be used to direct attention: Bottom - up, which is stimulus driven, and Top – down, which is user driven (Wolfe, 2002).

Bottom – up is a stimulus driven guidance to salient items and the attraction of attention to these important items can be contingent on task demands (Wolfe, 2003). Top – down can be response to explicit task demands or an implicit change in guidance, which is also known as a pop out (Wolfe, 2003).

Eye movements can vary depending upon the task an individual is involved in (Rayner, 2009). For example the eye movements in reading are different to those used in scene perception (Rayner, 2009). The fixation durations in scene perception tend to be longer and the saccades tend to be larger compared to those in reading (Rayner, 2009). The task for eye movements when reading is more defined compared to scene perception where the task or tasks is variable and liable to change (Rayner, 2009). This can be clearly demonstrated in sport where the scene perception is continually changing due to the environment, opponents, referees and the dynamic element of the sport.

2.4. The Social Cognition Perspective:

Plessner and Haar (2006) highlighted that previous research (e.g., Tenenbaum & Bar-Eli, 1993) have used a general decision making approach rather than a social cognition approach when researching decisions made by athletes. Social cognition follows an information processing framework and is concerned with the cognitive processes involved in making judgments, decisions and attributions (Bless, Fiedler & Strack, 2004). A sequence of information processing as a framework is illustrated in figure 2.1 as a dressage judging example.

Figure 2.1. The sequence of social information processing (Bless et al., 2004) applied to the example of a dressage judging task.

The specific stages of the social information processing states that the perceived stimulus (e.g., the judge needs to attend to the transition) is analysed and given significance (e.g., categorised as an untidy transition) which can be influenced by stored episodes in the memory (e.g., previous transitions have been miss-timed, unbalanced or early to walk) or the episode can be stored in the memory and could influence future judgments (Plessner & Haar, 2006). For the judge or coach to make the required decision (e.g., reduction in mark) the perceived and analysed information is processed along with previous knowledge and memories (Plessner & Hass, 2006).

It has been highlighted that inaccurate judgments can be made from incorrect information or small errors from different stages of the information processing when the framework has been applied to judging of sport performance (Plessner, 2005). For example, a judge's decision on a reduced mark or score could come from a memory that in the three previous transitions the horse was early to walk, therefore influencing the rest of the performance. However, previous research (MacMahon & Ste-Marie, 2002; Ste-Marie, 1999, 2000) has documented the differences in knowledge between experts and novices and when applied to the social cognition framework would suggest that expert judges and coaches should have different stored knowledge compared to novice judges and coaches. This therefore needs to be explored further to explore and identify these differences.

2.5. Previous Research:

There has been a lot of research done on comparing elite performers to novice performers within sport to investigate whether there is a distinct difference with visual eye movements (e.g., Casanova, Oliveira, Williams & Garganta, 2009; Hagemann, Schorer, Caṅal-Bruland, Lotz & Stauss, 2010; Hernández, Romero, Vaillo & Del Campo, 2006; Jarodzka, Scheiter, Gerjets & Van Gog, 2010; Memmert, Simons & Grimme, 2009; Savelsbergh, Williams, Van der Kamp & Ward, 2002; Wu, Zeng, Zhang, Wang, Wang, Tan, Zhu, Zhang & Zhang, 2013). This interest has also spread to other areas of research and Kasarskis, Stehwien, Hickox, Aretz and Wickens (2001) investigated whether there was a comparison in scan behaviours between expert and novice pilots. They found that expert pilots had more fixations and better defined eye scanning patterns compared to novice pilots (Kasarskis et al., 2001).

Decision making is an important component in the domain of sport and the greatest interest into the study of decision making is the Hick Law (Abernethy, 1991). There is a linear relationship between response uncertainty and reaction time (Abernethy, 1991). The delay of an athlete's reaction time increases linearly as the unanticipated visual stimulus-response increases (Abernethy, 1991). The extent to which an athlete's reaction time is delayed varies between individuals; however the delay is systematically less for experienced or elite athletes (Abernethy, 1991). This states that elite athletes should therefore have superior decision making skills compared to non-elite athletes. This can also be important for sport psychologists and coaches to provide them with intervention techniques that include increased visual stimuli and response speed for the athlete as earlier studies have done in fast racquet sports such as tennis (e.g., Abernethy & Russell, 1983; Glencross & Cibich, 1977).

Abernethy (1991) provides an explanation for the differences in reaction time between elite performers and non-elite stating that the task specific experience of an elite athlete aids in the development of a range of extremely efficient decision-making strategies. These strategies aid in reducing reaction time for the athlete by decreasing the amount of information processed by the athlete (Abernethy, 1991). Therefore, it is clear that the decision making processes are crucial to elite athletes (Bar-Eli & Raab, 2006). The speed and accuracy of decision making is mainly based upon the athlete's interpretive value of the visual information that is acquired through their perceptual skills (Janelle & Hillman, 2003).

The decision making process can be explained through two perspectives, the cognitive process and the social process (Chelladurai & Turner, 2006). The cognitive process emphasises the rationality of decision making and is concerned with evaluating the alternatives that are available and selecting the favoured one to achieve the desired outcome (Chelladurai & Turner, 2006). For an athlete to arrive at a rational decision they firstly need to define the current problem clearly, identify the relevant constraints to generate possible and plausible alternatives to the problem that is evaluated according to a selected criterion (Chelladurai & Turner, 2006). This suggests that athletes are required to identify the problem or the task required to complete the skill or execute the required movement by evaluating alternative decisions through specific criteria (Chelladurai & Turner, 2006).

The social process perspective looks at the degrees to which others are allowed to become involved in the decision making process and the influence that they may have on the decisions (Chelladurai & Turner, 2006). An example could be judges and the decision making of an athlete's score in aesthetic sports. For example, a judge may be influenced by other judges around them and also by spectators and supporters whilst making their decision.

Decision making and response planning rely on visual input and there has been concern as to whether and/or how increased anxiety can affect the visual attention field (Janelle, 2002). Therefore, there has been a great deal of research in to eye movements in athletes and the influence of anxiety on visual search strategies and visual attention. Janelle, Singer and Williams (1999) found that increased anxiety in a dual-task auto-racing simulation produced more eccentric visual search patterns and increased attentional narrowing. This suggests that drivers who are highly anxious have an altered ability to acquire the peripheral information at the perceptual level (Janelle et al., 1999).

Other research conducted in this area has examined the effects of anxiety on visual search strategy in karate comparing elite performers to non-elite (Willimas & Elliott, 1999). Their findings found that high anxiety increased the rate of visual scanning and the number of peripheral fixations (Williams & Elliott, 1999). Further findings provided support for experts' superior perceptual skill in dynamic sport situations to successful performance (Williams & Elliott, 1999).

The findings from this research within the area of anxiety and visual search strategies can provide applied sports psychologists with information on the effects of anxiety on visual patterns and fixations to provide them with knowledge relevant to intervention strategies. It also provides them with knowledge of how elite athletes' perceptual skills are superior allowing for the possibility of improvement strategies.

A lot of the research in sport and visual strategies has also been conducted within the sport of football and specifically in the area of goal tending for goal keepers (e.g., Bard & Fleury, 1981; Savelsbergh, Williams, Van Der Kamp, & Ward, 2002; 2005; Williams & Burwitz, 1993). Some of this research has identified that the advanced cues from the shooter's body (e.g., hip, kicking leg, supporting leg) are the most important (Savelsbergh et al., 2002; 2005; Williams & Burwitz, 1993), whereas other studies have identified that tracking the object prior to and during the movement is most essential for goalkeepers (Bard & Fleury, 1981).

A similar study done in ice hockey (Panchuk & Vickers, 2006) found that the visual fixations were focused on the puck and the stick, which is similar to the findings of Bard and Fleury (1981). However, the results also found that there were virtually no fixations directed at the shooters body, which differs from the football research by Savelsbergh et al. (2002; 2005) and Williams and Burwitz (1993). Another study looked at defensive tactics in ice hockey comparing elite athletes to near-elite (Martell & Vickers, 2004). They found that the elite athletes directed their fixation over a short duration to specific locations in the environment as the play developed and they had a longer duration of fixations on a relatively stable location or stimuli in the final phase of a set play compared to the near-elite athletes (Martell & Vickers, 2004). These findings are useful to an applied sport psychologist because it can suggest that elite athletes adapt their visual behaviour during play and more importantly suggests that significant body parts and especially the object of play (e.g. football, puck, and stick) are the required stimuli to focus attention on.

2.6. Research with Judges:

Another area of interest has begun to move away from athletes and examine judges instead. The visual search patterns of judges has become an important topic in sport as 1/3 of Olympic sports have a performance rating system where judging plays a major role (Plessner & Haar, 2006; Stefani, 1998). The majority of judging is in aesthetic sports (e.g., gymnastics, figure skating, platform diving, synchronized swimming, rope skipping and dressage) and is susceptible to non-performance based factors such as the spectators and the coach of the athlete (Boen, Auweele, Claes, Feys, & Cuyper, 2006). This is due to panel judging being a human judgement process that can be influenced by numerous biases (Boen et al., 2006; Landers, 1970). For example, research by Ste-Marie and Lee (1991) found unintentional memory influences from a prior episode or experience were a source for perceptual bias. They found that judges were unable to discount the influence from these prior experiences of exposures on their visual perception of a gymnasts move or routine; i.e. exposure to a gymnasts warm up of their routine was an influential source of perceptual bias (Ste-Marie & Lee, 1991). Therefore, for an applied sport psychologist and a coach working with these athletes it is important that they can identify to an athlete what part of a movement, technique or body positioning a judge/s are looking at when assessing the athlete's performance. This can then aid the athlete to master their performance to the optimal and required level. This is inherently useful for the coach as during coaching sessions they can work with the athlete to identify together what the required movement(s) need to be improved.

This suggests it is important to look at judgement and decision making within this area. The study into judgment and decision making can be traced back to the late 1940's in the disciplines of main stream psychology (Bar-Eli & Raab, 2006). According to

Tenenbaum (2003) none of the findings from the research on judgement and decision making were represented in sport psychology literature until Straub and Williams (1984) published their collection of papers examining cognitive sport psychology. At this time Gilovich (1984) stated that the discipline of sport is most appropriate for the development of judgement and decision making as it has the potential laboratory expertise to carry out the study of cognitive processes associated with the judgements and decision making of humans.

Therefore, when judgements are made in sporting environments they can be classified as knowledge based decision making that is dependent upon evaluative and inferential processes derived partly from sensory information (Koehler & Harvey, 2004).

Previous research has highlighted observation as a key principle to superior performance in sport, which is also apparent when judging a sport (Mann, Williams, Ward, & Janelle, 2007). However, it is the mechanisms of perceptual-cognitive skills that contribute to the advantages that an expert posses (Mann et al., 2007). These perceptual-cognitive skills are an individual's ability to identify and acquire environmental information and cues which integrates with their existing knowledge so that the appropriate responses and actions can be selected and executed (Marteniuk, 1976; Williams, 2002). However, these mechanisms that contribute to expertise of sporting performance are less evident and require research (Mann et al., 2007).

In a sporting environment there is a vast amount of information available to an athlete and for an athlete to be a successful performer it is essential that they are able to identify where and when to look (Mann et al., 2007). Therefore, elite sport performers must be able to identify and direct their attention to the appropriate stimuli and also be able to extract efficient and effective meaning from what they attend to (Williams et al, 1999).

Research has shown that because an expert posse's extensive procedural and declarative knowledge and are more proficient at making decisions this enables them to extract important information from the environment to anticipate and predict future outcomes and events (French & Thomas, 1987; French, Spurgeon, & Nevett, 1995; Holyoak, 1991; McPherson, 1999, 2000; Williams et al, 1999). This can be supported in the research of judges, which has found that expert judges develop effective anticipatory strategies that help improve decision making (MacMahon & Ste-Marie, 2002; Paull & Glencross, 1997; Ste-Marie, 1998, 2000).

It has been demonstrated across sporting domains the enhanced perceptual-cognitive skills, such as selective and effective attention, that expert athletes' posses and this has led to further research into the role and development of perceptual skill acquisition in sport expertise (Abernethy & Russell, 1987). A lot of this research has emphasised how expert performers learn to acquire perceptual cues and also the understanding of the ability of expert performers to process precise information (Abernethy, 1999).

Previous research has compared elite athletes to novice athletes to identify the unique perceptual-cognitive skills that an expert performer posses (e.g., Fairchild, Johnson, Babcock, & Pelz, 2001; Savelsbergh, et al., 2002; Williams, Davids, Burwitz, & Williams, 1994). This research found that experienced performers demonstrated more appropriate and efficient visual search strategies than the inexperienced athletes (Williams, 2002).

When comparing elite to non-elite performers some contemporary research has looked at the location of ocular fixations across the performance display and found that expert performers showed systematic differences in their location; suggesting enhanced selective attention processes (e.g., Ripoll, Kerlirzin, Stein, & Reine, 1995; Vickers, 1992; Williams et al., 1994). Furthermore, other research has observed differences in the search rate where expert performers use a more efficient search pattern that involves fewer fixations of a longer duration (e.g., Caṅal-Bruland, Lotz, Hagemann, Schorer & Strauss, 2012; Helsen & Pauwels, 1993; Hernàndez et al., 2006; Rippoll et al., 1995). This would suggest that expert performers have a greater refined perceptual strategy that is directed towards the pertinent areas and stimuli within the environment (Williams & Davids, 1998).

Similar findings have been found in research with judges and referees, for example in gymnastics expert and novice judges were found to differ in their visual search strategies (Bard, Fleury, Carrière, & Hallé, 1980). These differences consisted of the expert judges making fewer fixations than the novice judges and the location of where the expert judges fixated were significantly different to where the novice judges located their fixations (Bard et al., 1980). A similar study again looked at the visual search strategies employed by experienced and inexperienced gymnastic coaches (Moreno, Reina, Luis, & Sabido, 2002). Moreno et al. (2002) found that the experts made fewer fixations than the novices. However, the experts made longer fixations than the novices supporting previous claims that experts exhibit more selective and non-active search strategies (Williams et al., 1999). This supports the assumption that experts have knowledge of where the most informative areas of display are, therefore, are able to ignore the areas of display that provide little information (Moreno et al., 2002).

Another, gymnastic study found that expert judges were significantly better at perceptually anticipating upcoming gymnastic elements compared to non-expert judges (Ste-Marie, 1998). This supports previous claims that elite judges have enhanced selective attention processes (Ripoll, et al., 1995; Plessner & Haar, 2006; Vickers, 1992; Williams et al., 1994). Therefore, suggesting that there are similar requirements for visual perceptions for elite performers and elite judges.

Research has also investigated the visual behaviour of coaches (Hernández et al., 2006) and looked at comparing the eye movement patterns of coaches and judges (Page, Lafferty, & Wheeler, 2007). Hernández et al. (2006) found that over three conditions the expert coaches had fewer fixations compared to the novice coaches. Furthermore, the findings revealed that over practice the coaches reduced the number of visual fixations suggesting that their attention is reduced in later trials (Hernández et al., 2006). These findings may be due to the coaches' efficiency at retrieving information from the memory, which allows them to use prior knowledge within in the memory, therefore enhancing selective attention (Logan, 1988).

The study comparing coaches and judges in the sport of gymnastics found that there were no significant differences between the number and duration of fixations and the number of areas being fixated on (Page et al., 2007). These findings provide evidence that coaches and judges have similar search patterns when they are assessing and judging a performance (Page et al., 2007). Page et al. (2007) state that these results have implications in the domain of perceptual training and allow for the development of eye patterns to be trained which would then produce a more effective scan pattern.

It is important to consider that differences do exist across the varying roles in sport. For instance, judges and referees are involved more closely to the perception and decision making aspects, without a strong need for an action component, whereas athletes are tied much more to the involvement in the perception action link of sport performance (Plessner & Betsch, 2001). Despite these differences that exist among these two roles, certain similarities are also evident; for example, all are responsible for the searching of relevant information from a moving display that results in decisions based not only on the perceptual information, but on the stored factual and experimental knowledge (Plessner & Betsch, 2001).

2.7. Judging within Dressage:

Eventing consists of the three disciplines dressage, show jumping and cross country, with dressage often considered to be the most difficult (Evans & Franklin, 2010). Dressage focuses on the movements of the horse and rider over a complex course situated in a small arena approximately 20 metres by 40 (or 60) metres (Evans & Franklin, 2010). The movements are referred to as 'ground work' due to the horse completing specific steps, paces and gaits on the ground (Evans & Franklin, 2010). Dressage also requires the horse and rider to stipulate a number of varied paces and the transitions between the paces, for example, walk, trot, lengthening and canter, which are scrutinised by the judges and need to be performed smoothly and instantly when instructed by the rider (Evans & Franklin, 2010).

The dressage tests range in difficulty from introductory to Olympic standard and score the rider and horse on general competencies and specific figures (Evans & Franklin, 2010). The movements have to be performed within specific areas of the arena, attracting a mark out of ten to be awarded by the judges (Evans & Franklin, 2010). Furthermore, collective marks are awarded to the horse and rider for paces, impulsion, submission, position and seat of the rider including correct usage of aids (Evans & Franklin, 2010).

Judges are categorised by list and the lists range from six to one where list six judges can judge preliminary competitions and list one judges can judge grand prix tests at championships (http://www.britishdressage.co.uk/judging).

2.8. Limitations:

The development of visual research has been productive and informative for the area of sport psychology, however, there are still limitations to the existing research, which is a critical factor when studying and researching expert performance (Mann et al., 2007). There are concerns relating to the ability of creating experimental tasks and the experimental conditions allowing the advantages of an expert to emerge (Ericsson & Smith, 1991). It is therefore paramount for researchers to attempt to reproduce this advantage to the highest standard (Mann et al., 2007). Previous studies have employed slide presentations and the use of filming the athlete or sport through video recording and playing back on a small screen display, potentially altering the perceptual and sensory experience (Issacs & Finch, 1983; Williams et al., 1992; 1994). Valuable information can be revealed when recording eye movements as it allows testing to be conducted in ecological situations and the subjects are placed in experimental situations identical to real performances (Goulet, Bard & Fleury, 1989). It allows for the selection, identification and filtering of the most informative cues and allows for the quantification of the amount of information selected (number of fixations per unit of time) and for the establishment of a visual search strategy (scan path) (Goulet, Bard & Fleury, 1989).

2.9. Research Design:

All the research discussed previously has identified and compared elite to non-elite either as athletes or as judges. Therefore, it would be interesting to investigate the visual scan patterns of an elite judge, an elite coach and a novice judge to compare or to see if their visual scan patterns vary and if so to provide ideas and recommendations that could be implemented into future coaching and training.

Due to time restraints and availability the research will be a single subject design comparing one elite judge, one elite coach and one novice judge. This method can be supported by previous research within visual search strategies that have taken a similar design or have used low subject numbers including Halligan & Marshall, (1993); Kastner, Pinsk, De Weerd, Desimone & Ungerleider, (1999); Moran, Byrne & McGlade, (2002); Moreno, Reina, Luis & Sabido, (2002);

Throughout the past two decades researchers within sport psychology have insisted upon the increase in single-subject designed research for enhancing sport performance (Bryan, 1987; Martin, Thompson & Regehr, 2004; Wollman, 1986). Sport psychology researchers can implement single-subject designs to assess the effects of psychological interventions upon athletic performance during practices and competitions (Hrycaiko & Martin, 1996). Compared to a group design where the researcher looks at the average performance for each group a single-subject design allows the researcher to look at individual athletes and their performance. This allows the researcher to focus on repeated measures of the athlete's performance during practice and competition, which then provides them with valuable information on the individual's variation within their performance (Hrycaiko & Martin, 1996).

Single-subject designs usually have between three to five subjects, which allow the researcher to easily gain the effective number of relevant athletes compared to a group design (Hrycaiko &Martin, 1996). This is relevant to the current research as elite athletes can be difficult to recruit in sufficiently large numbers to meet the required sample size that group designs demand (Kinugasa, Cerin & Hooper, 2004).

Another advantage to single-subject designs is that subtle behavioural changes can be identified whereas they may go undetected in a group design technique (Vealey, 1988).

Furthermore, single participant designs have been championed as a practitioner friendly alternative to evaluating interventions in practical settings (Hrycaiko & Martin, 1996).

3. Method:

3.1. Participants:

Two female British dressage judges and one female British dressage coach with a mean age of 49 years (*SD* = 6.93) were recruited from the North West region representing 70% of the proposed sample size in the North West for elite judges. There were three participants overall due to the time constraints of the data generation for the visual analysis as reported in previous studies (Al-Abood, Bennett, Hernandez, Ashford & Davis, 2002; Hernandez et al., 2006; Williams & Davids, 1998; Williams & Elliott, 1999). All three participants provided informed consent (Appendix one) and health questionnaires (Appendix two) before participating in the study.

Participants were classified as elite by either, having judged at regional, national or, international level. All participants had normal or corrected vision when using the eye tracker.

3.2. Apparatus:

Visual search data was collected using the ASL 501 eye tracking device, as shown in figure one. The head mounted monocular eye tracking device uses a corneal reflection to measure participant's eye line of gaze (Nevalainen & Sajaniemi, 2004 & Panchuck & Vickers, 2011). The device uses only one eye of the participant to record eye tracking and the precision of this device is 0.5° of visual angle (Nevalainen & Sajaniemi, 2004 & Panchuck & Vickers, 2011).

Figure 3.1. ASL 501 Eye Tracker.

The model 5000 control unit was used which processes the eye camera signal and produces the cross hair on to the video image.

Real-time video performances were used on a large-screen display to try and increase elite advantages that may occur as they would in a competition environment. Therefore, reducing the concerns highlighted in previous research to the ability of creating experimental tasks and the experimental conditions (Ericsson & Smith, 1991). Previous studies have employed slide presentations and the use of filming the athlete or sport through video recording and playing back on a small screen display, potentially altering the perceptual and sensory experience (Issacs & Finch, 1983; Williams et al., 1992; 1994). Therefore, using a large screen display will decrease the potential of altering these perceptual and sensory experiences.

The set up of the eye tracking equipment is identical to the research done by Page (2009), which is shown in figure two.

Figure 3.2. Set up of eye tracking equipment (Page, 2009)

3.3. Film Footage:

The film footage was created from a novice dressage competition, which was compressed to three different dressage competitors. The footage was filmed from the position of where the judges were seated to provide the dynamics of a natural environment for the three participants (Omodei, McLennan & Whitford, 1998). This provides the participants with the environment of judging the footage as if they were at the competition and minimising the distortion of the complexity (Omodei et al., 1998).

3.4. Procedure:

Each participant had to go through a set up stage. This included the participant being seated and their location being adjusted in relation to the eye tracking device. Also, because the eye tracking device was head mounted it had to be placed onto the participants head and adjusted accordingly for each participant.

The next phase that each participant followed was the calibration phase. The calibration pattern identical to that in figure two was shown to each participant. The participants were instructed by the researcher to direct their gaze to each of the calibration points e.g. top left, top middle and top right defines the calibration points for the top line shown in figure three.

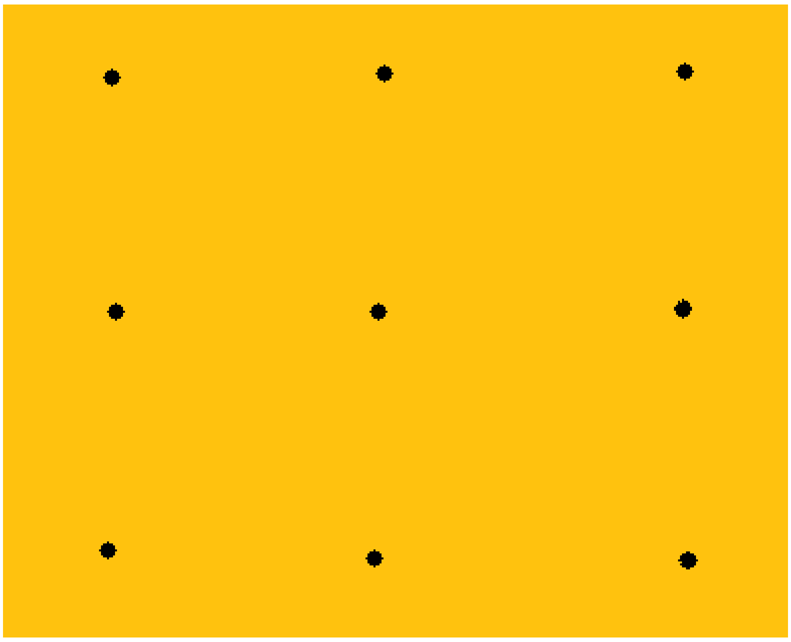


Figure 3.3. Calibration Points.

Each participant had a five minute practice test to become familiar and comfortable with the equipment and the procedure.

The participants watched the same three dressage tests, which were of three novice dressage tests, whilst wearing the ASL 501 eye tracker. Each test lasted approximately six minutes. Whilst watching the dressage tests the participant's eye gaze was recorded onto a video camera, which would then play over the top of the dressage footage to show where the participants gaze was fixating.

Whilst watching each dressage test the participants scored the movements in the tests in line with British dressage criteria as if they were actually judging the dressage test in a competition environment.

3.5. Data Analysis:

The visual scan patterns of the judges were placed over the video dressage sequence to analyse the eye tracking data by recording the number of fixations, the duration of the fixations and the location of the fixations. To extract this data a frame by frame analysis was done for each dressage test and for each participant.

To be able to collate and analyse all the data it had to be inputted onto a spreadsheet showing the location of where each participant was fixating, the time duration of the fixations and the movements throughout the dressage test for each horse. Figure four shows the key used to record the initial locations of each participant's fixations during each dressage test.

A fixation was defined as when the eye remained stationary for a period equal to or greater than 120ms or for six frames.

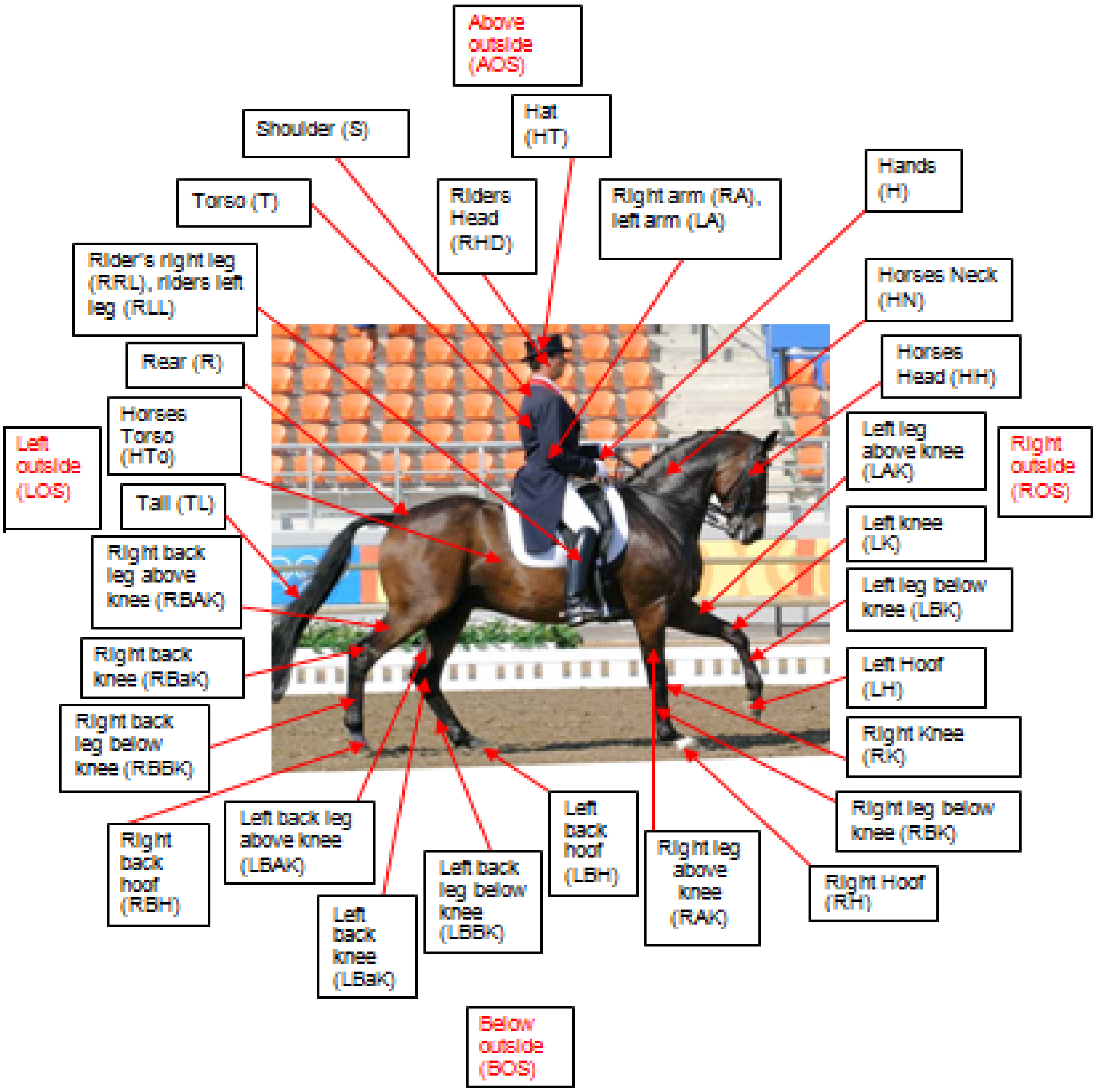


Figure 3.4. Key

Once all the data was collated into the spreadsheets the analysis had to progress to narrow the data down. The numbers of movements were compressed into nineteen and the locations of the fixations were compressed to the main areas of A1, A2, A3, B1, B2, B3, AOS, ROS, LOS and BOS. This is seen in figure five and was applied for example in the following way, if a participant had fixations in locations on and around the horses head or neck this would be placed into area A3. If the participants had fixations on locations around the tail or left back knee then this would be placed into area B1. If the participants were fixating outside of the dressage video for example above the video clip then this would be placed into area AOS.

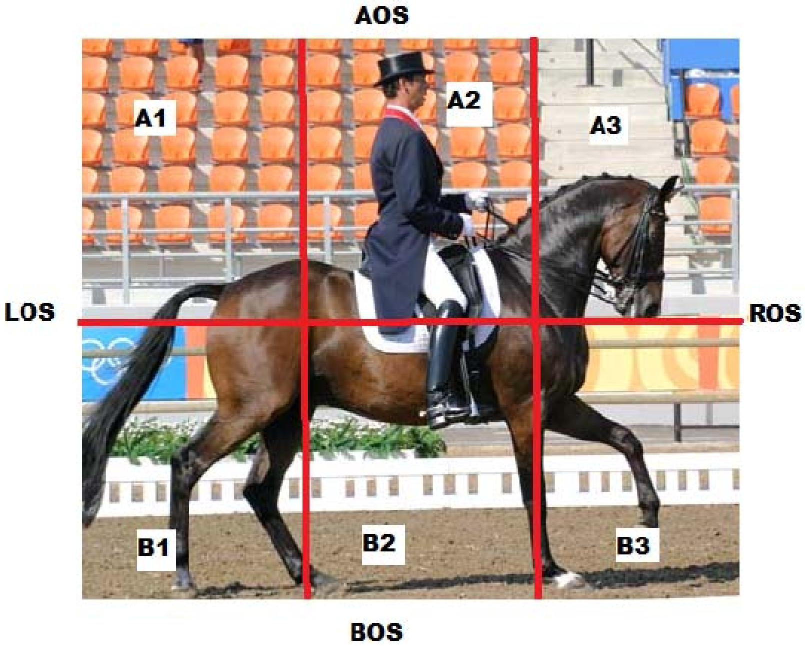


Figure 3.5. Key Two.

The results were then analysed further by collating them into the total number of fixations for each movement and the total time taken fixating during each movement. These results were then produced into graphs to be able to see the patterns and variations of the three participants visual scan patterns.

The locations of the fixations were compressed further to be able to produce a visual comparison in a graph. The movements were put into sections 1-6, 7-12 and 13-19 showing how many fixations of the various locations occurred in each of the movement sections. The total number of each location were then calculated to produce a graph to show how many times each participant fixated during each dressage test on the specific locations of A1, A2, A3, B1, B2, B3, AOS, ROS, BOS and LOS.

3.6. Results Report:

Once the data was all collated a case comparison was conducted comparing the results of the novice judge and the results of the elite coach against the results of the elite judge. This included descriptive analysis of all three participants highlighting the similarities or differences between them and highlighting why these similarities or differences have occurred against previous research.

4. Results:

The purpose of this study was to determine if there were similarities between the visual search patterns of an elite coach and a novice judge compared to an elite judge in the sport of dressage. Several analyses were conducted on the data to examine the comparisons between the three participants.

There were three comparisons made of the results which included comparing the number of fixations made, the location of where each participant is looking and the time each participant takes fixating during the movements within a dressage test.

4.1. Participant.1. Expert Coach:

The first condition that was analysed was the number of fixations that were made during each movement in the dressage test. Figure 4.1 shows the number of fixations made per movement for each of the three horses.

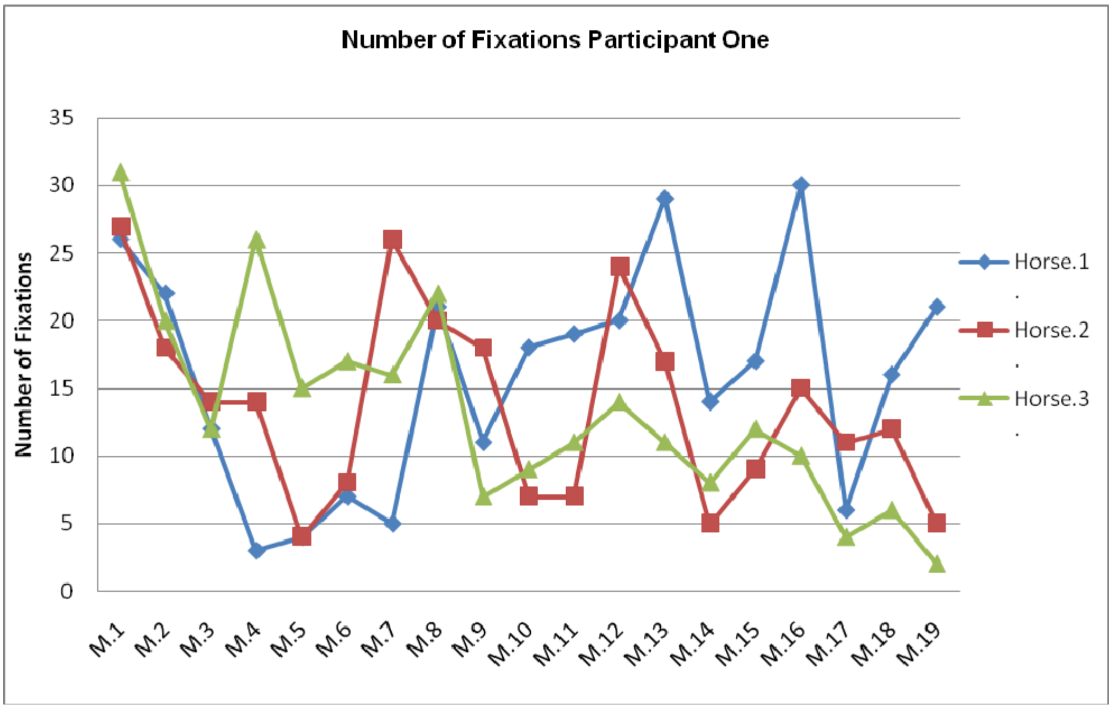


Figure 4.1: Number of Fixations for Participant One.

The graph shows some similarities, for example movement eight shows the most identical number of fixations for all three horses. The graph also shows a partial pattern where participant one increases or decreases the number of fixations during certain movements, this can be shown in the peaks and troths on the graph.

The next condition analysed was the amount of time taken fixating during each movement by participant one. Figure 4.2 shows the total time taken fixating during each movement of the dressage test for each horse.

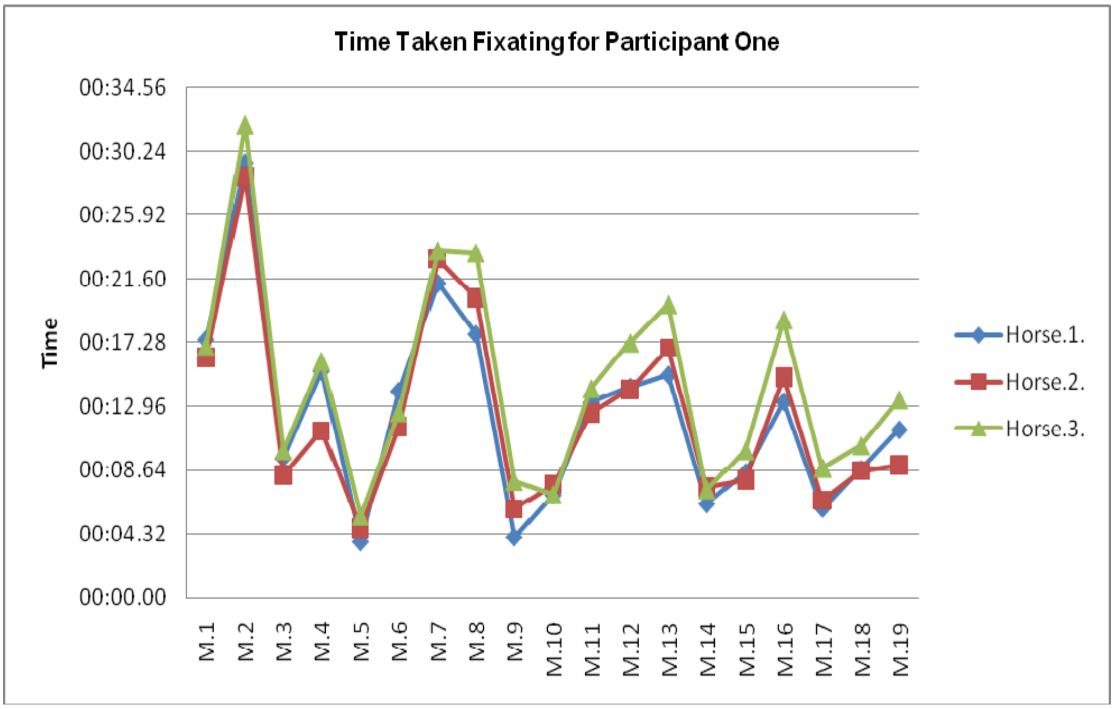


Figure 4.2: Time Taken Fixating Per Movement for Participant One.

It is clear to see the pattern for each horse is virtually identical for each movement. Showing us that participant one fixated for the same amount of time during each movement of the three dressage tests. This also tells us even though the number of fixations varied within the movements between the three horses the actual amount of time fixating did not.

The final condition that was analysed was the location of where the participants were fixating whilst judging the three dressage tests. This analysis looked at sections of the dressage tests combining movements one to six, seven to twelve and then movements thirteen to nineteen.

This analysis is shown in table 4.1, which tells us that participant one predominantly fixates in location B1 (below the mid line behind the horse), B2 (below the mid line in the centre of the horse) and B3 (below the mid line in front of the horse) during all three dressage tests.

H.1. P.1.	M.1-6	M.7-12	M.13-19	Total
A1	7	5	2	14
A2	8	3	1	12
A3	15	4	3	22
B1	7	26	24	57
B2	1	10	14	25
B3	20	19	43	82
ROS	10	23	25	58
BOS	3	2	20	25
AOS	3	1	0	4
LOS	0	1	0	1

H.2. P.1	M.1-6	M.7-12	M.13-19	Total
A1	8	14	2	24
A2	4	2	2	8
A3	8	2	0	10
B1	15	43	27	85
B2	13	17	15	45
B3	37	16	20	73
ROS	5	8	7	20
BOS	0	0	0	0
AOS	0	0	1	1
LOS	0	0	0	0

H.3. P.1	M.1-6	M.7-12	M.13-19	Total
A1	9	3	1	13
A2	3	2	0	5
A3	4	1	0	5
B1	23	21	18	62
B2	23	18	16	57
B3	45	21	14	80
ROS	3	2	0	5
BOS	2	1	2	5
AOS	0	0	1	1
LOS	0	0	0	0

Table 4.1: Location of Fixations for Participant One.

Figure 4.3 illustrates the total number of fixations made in each area during the three dressage tests. The graph clearly shows that during the tests locations B1 (below the mid line behind the horse), B2 (below the mid line in the centre of the horse) and B3 (below the mid line in front of the horse) have the highest number of fixations.

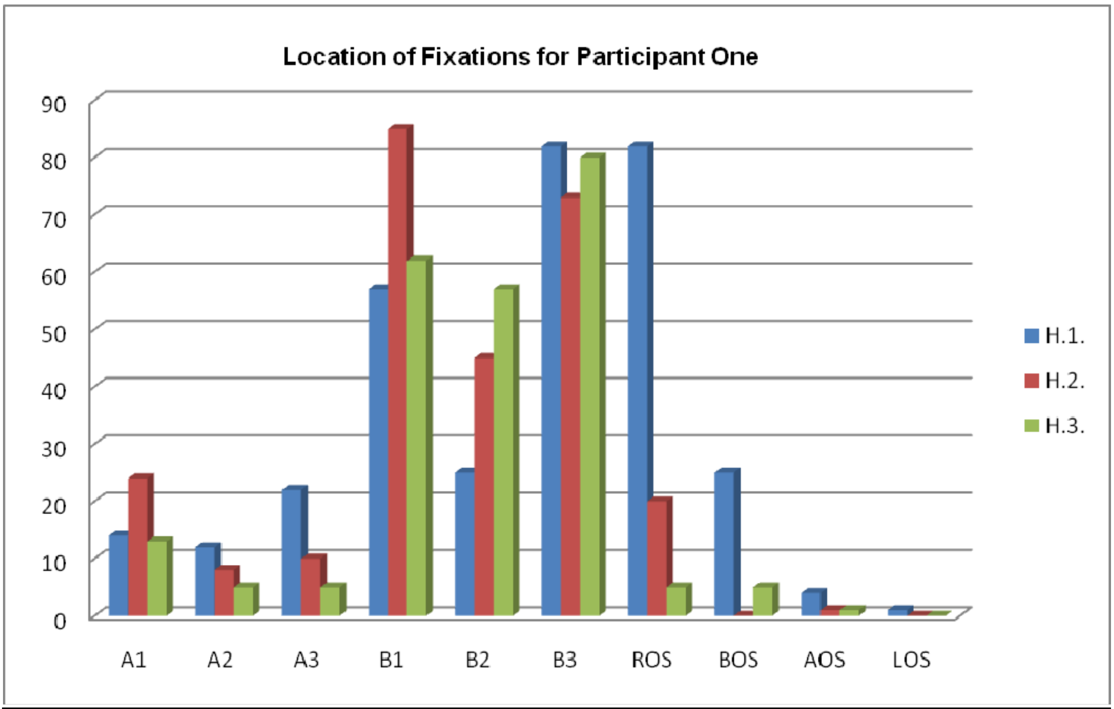


Figure 4.3: Location of Fixations for Participant One.

4.2. Participant. 2. Expert Judge:

The first condition for participant two is displayed in figure 4.4. This graph shows the number of fixations follow a similar pattern for horse one and two. However, even though the pattern for horse three peaks on the same movements as the other horses it seems that the number of fixations increased during this dressage test.

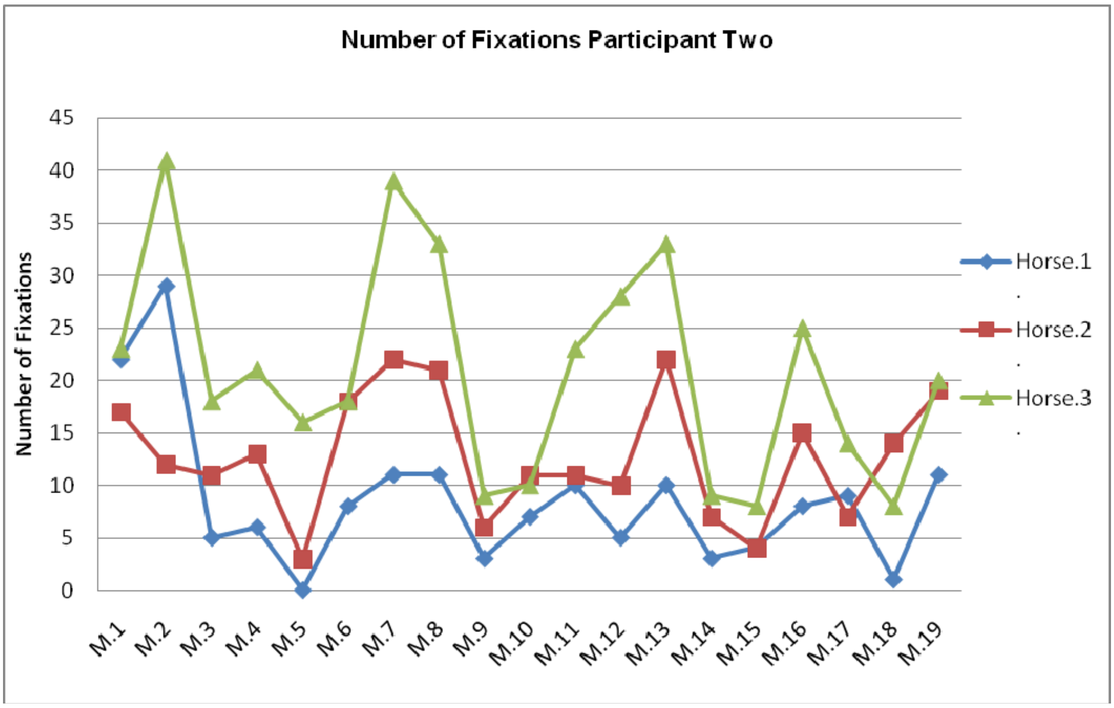


Figure 4.4: Number of Fixations for Participant Two.

The next condition of the total time taken fixating per movement is illustrated in figure 4.5. The total time follows a similar pattern for each dressage test, however, it will be examined further when a comparison is made between all three participants as the total time for participant two should be greater as an expert judge.

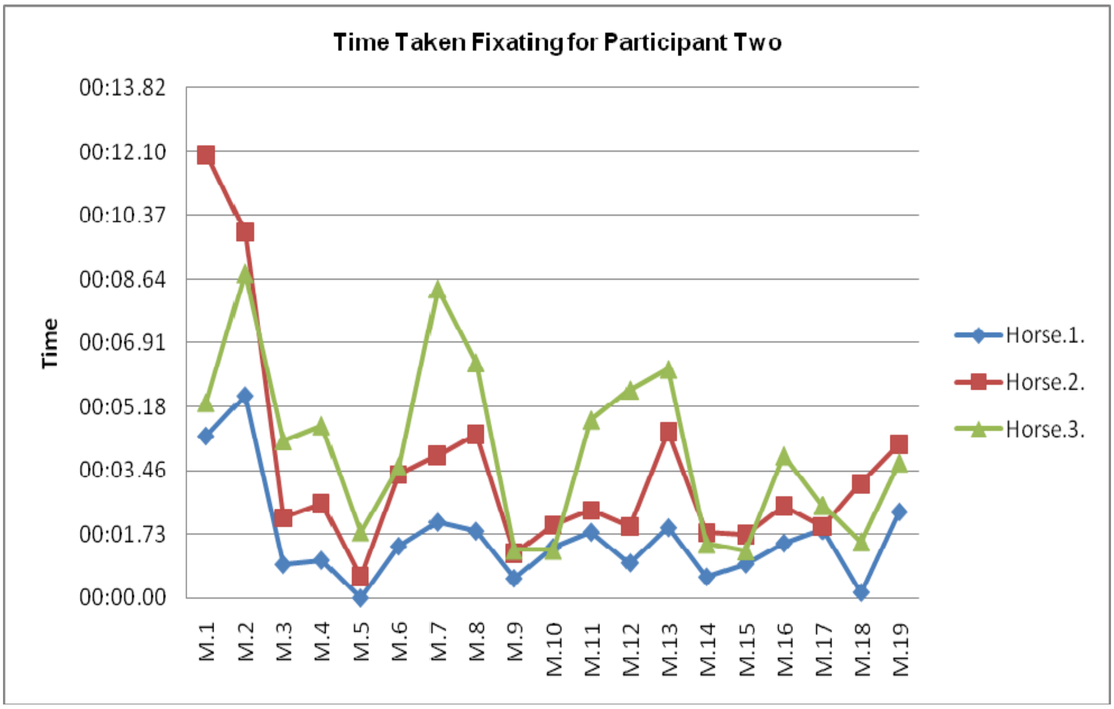


Figure 4.5: Time Taken Fixating Per Movement for Participant Two.

Table 4.2 displays the location of where participant two is fixating during the series of movements for each horse. The location that stands out in table 4.2 and also in figure 4.6 is A3 (above the mid line in front of the horse). Also B3 (below the mid line in front of the horse) is the next location where participant two has fixated more during all three tests.

H.1. P.2.	M.1-6	M.7-12	M.13-19	Total
A1	6	6	3	15
A2	4	2	1	7
A3	17	4	2	23
B1	3	9	4	16
B2	0	1	0	1
B3	9	6	14	29
ROS	0	2	0	2
BOS	4	6	17	27
AOS	25	7	2	34
LOS	2	4	3	9

H.2. P.2.	M.1-6	M.7-12	M.13-19	Total
A1	4	9	16	29
A2	4	9	8	21
A3	16	12	27	55
B1	5	15	8	28
B2	4	0	0	4
B3	17	16	18	51
ROS	3	3	1	7
BOS	6	3	0	9
AOS	17	12	10	39
LOS	4	1	0	5

H.3. P.2.	M.1-6	M.7-12	M.13-19	Total
A1	18	27	16	61
A2	11	27	12	50
A3	38	40	36	114
B1	15	28	16	59
B2	6	2	2	10
B3	35	14	18	67
ROS	3	0	4	7
BOS	1	0	0	1
AOS	3	4	12	19
LOS	0	0	1	1

Table 4.2: Location of Fixations for Participant Two.

It is clear in figure 4.6 that the number of fixations increase from horse one to horse three for the majority of locations i.e. A1-A3 (above the mid line) and B1-B3 (below the mid line). This could suggest that as the participant becomes familiarised with this specific dressage test then they become more aware of the locations they need to focus on.

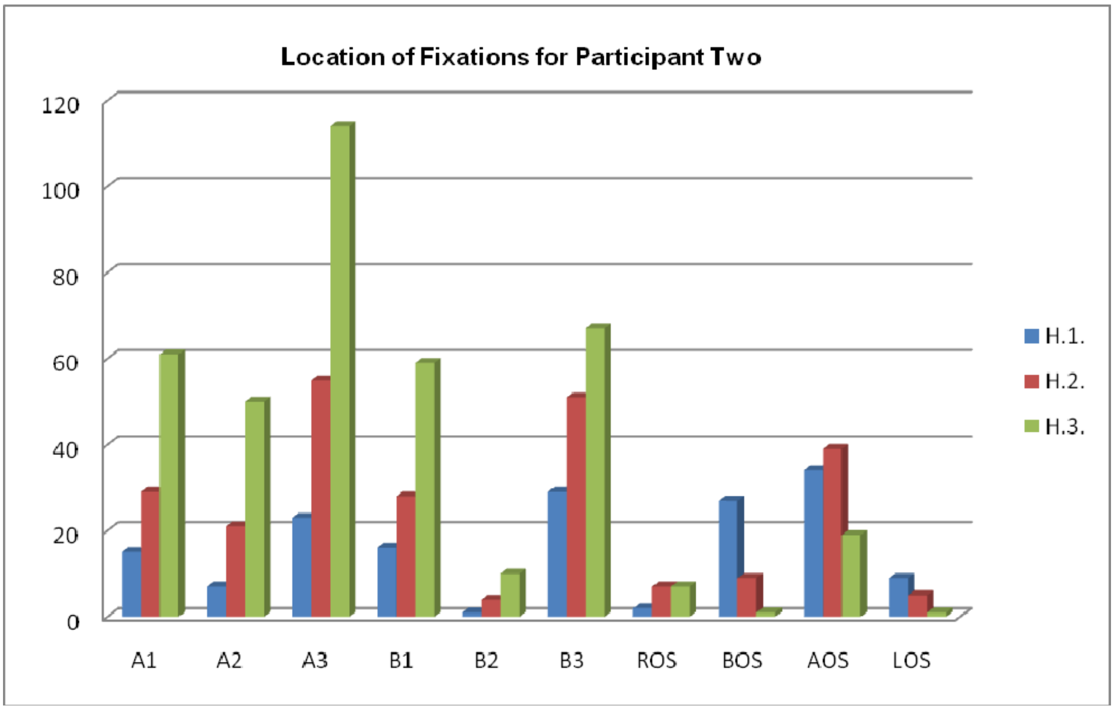


Figure 4.6: Location of Fixations for Participant Two.

4.3. Participant. 3. Novice Judge:

Condition one is illustrated in figure 4.7 and as a novice the number of fixations should be greater than those of participants one and two. This will be analysed further in the comparison section of the results.

The graph does show similarities in where the number of fixations peak and drop for certain movements for example movements three, seven, eight, thirteen and nineteen show similar patterns for all three horses.

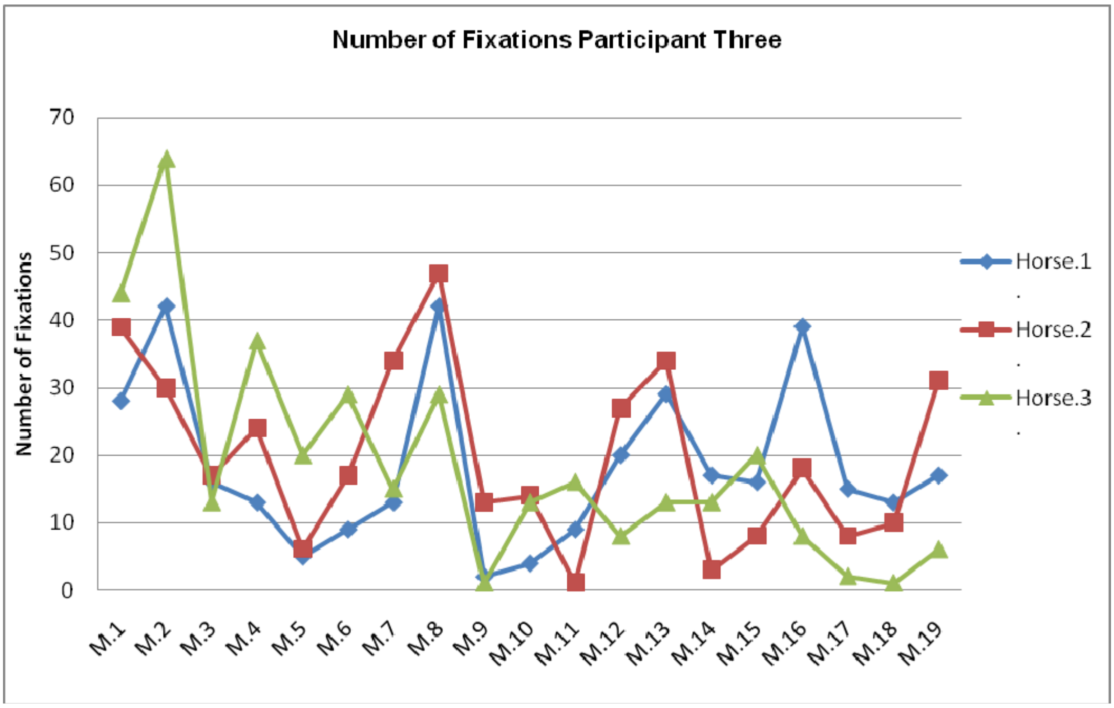


Figure 4.7: Number of Fixations for Participant Three.

The analysis for condition two on participant three is shown in figure 4.8. It is clearly visible that the time taken fixating shows a similar pattern for all three horses during the dressage test. Comparing the number of fixations in figure 4.7 to the total time in figure 4.8 shows that even though participant three had a high number of fixations throughout the movements the total time is reduced in comparison.

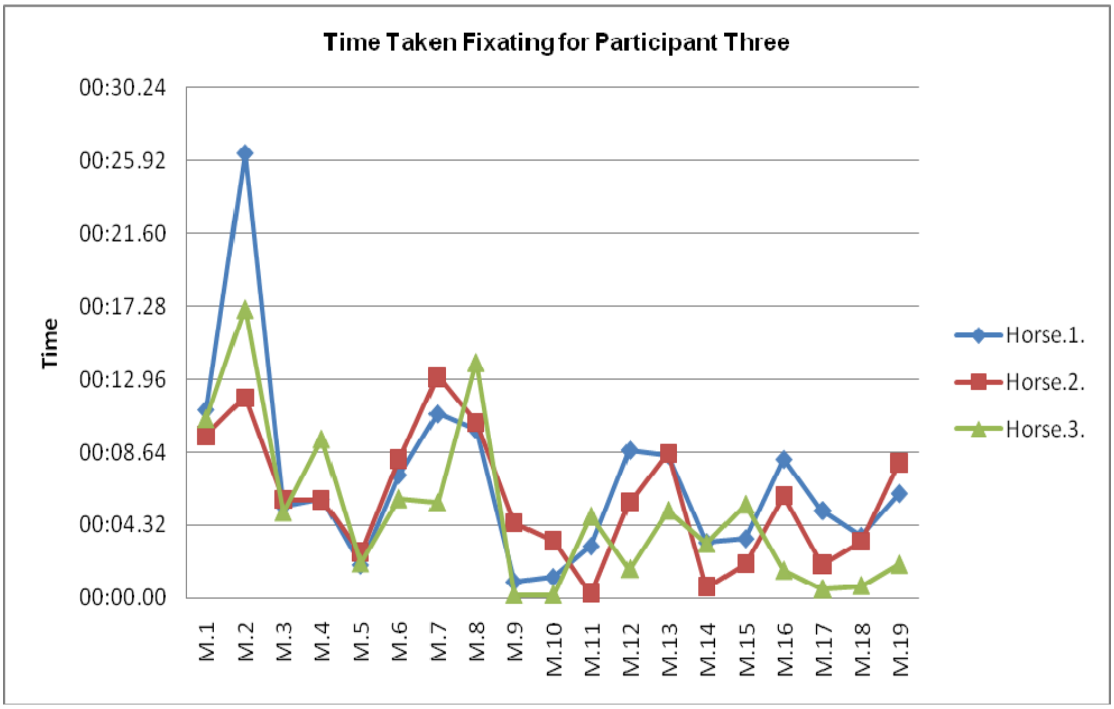


Figure 4.8: Time Taken Fixating Per Movement for Participant Three.

The final condition of location is shown in table 4.3 and in figure 4.9, which reveal location A3 (above the mid line in front of the horse) as the location that has the most fixations for all three horses. The table and the graph show that participant three only located their fixations in a minority of locations but as they moved onto judging horse two and three their locations increased.

H.1. P.3.	M.1-6	M.7-12	M.13-19	Total
A1	16	13	25	54
A2	14	4	11	29
A3	33	22	37	92
B1	7	8	17	32
B2	1	0	4	5

H.2. P.3.	M.1-6	M.7-12	M.13-19	Total
A1	13	23	14	50
A2	14	13	8	35
A3	56	25	30	111
B1	12	15	5	32
B2	0	2	0	2
B3	19	10	15	44
ROS	19	34	26	79
BOS	2	6	0	8
AOS	15	8	13	36
LOS	2	0	1	3

H.3. P.3.	M.1-6	M.7-12	M.13-19	Total
A1	42	27	16	85
A2	12	27	12	51
A3	52	40	36	128
B1	11	28	16	55
B2	2	2	2	6
B3	23	14	18	55
ROS	28	0	4	32
BOS	2	0	0	2
AOS	20	4	12	36
LOS	4	0	1	5

Table 4.3: Location of Fixations for Participant Three.

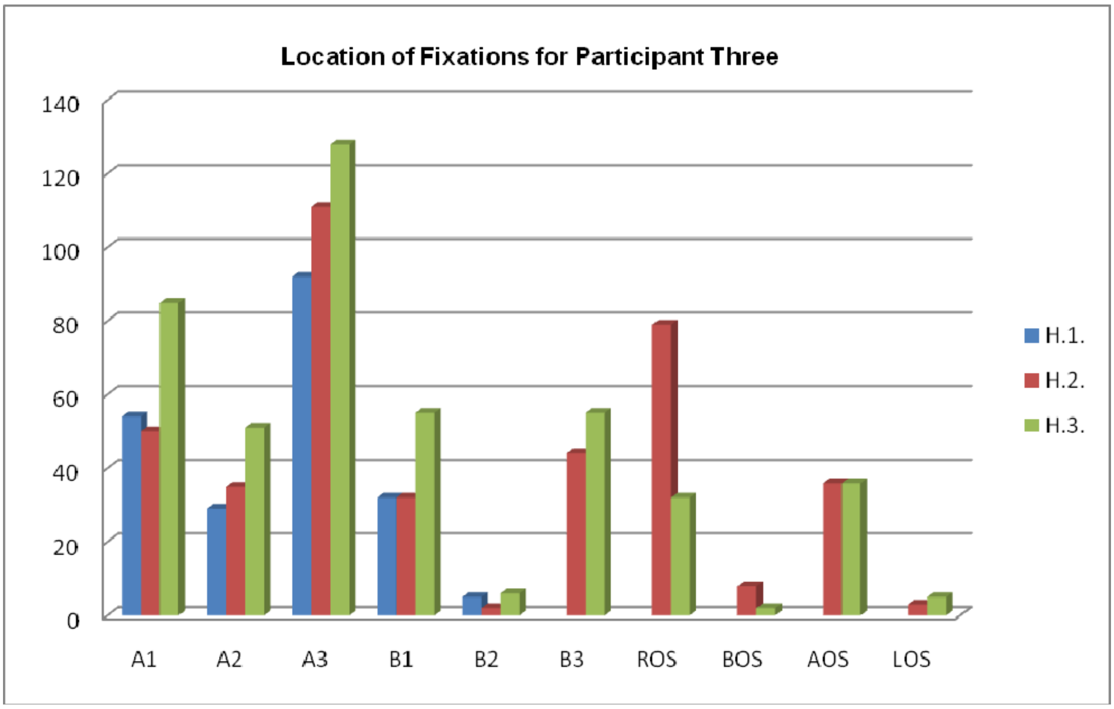


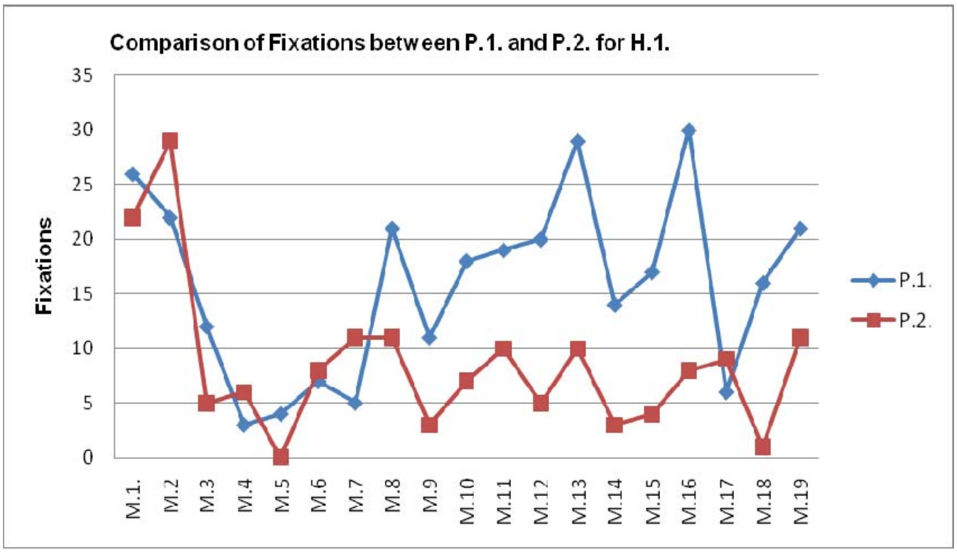
Figure 4.9: Location of Fixations for Participant Three.

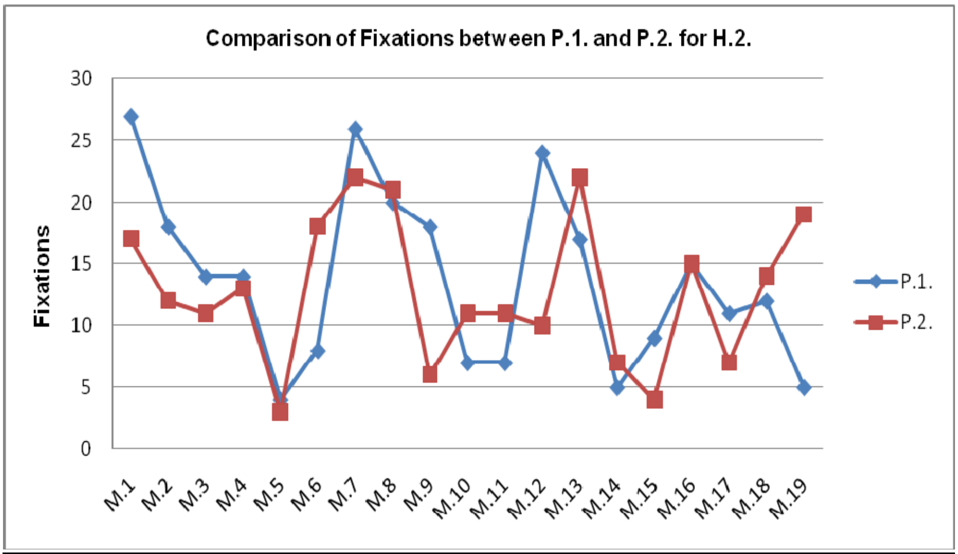
After analysing each participant's results for the number of fixations, the total time of fixations and the location of fixations a comparison were then made between the three participants.

<u>4.4. Comparison of Fixations between Participant one (Expert Coach) and two (Expert Judge):</u>

The first comparison made was between participant one the expert coach and participant two the expert judge to see if these two experts had similar visual search patterns.

Figure 4.10 displays the comparison between participant one and participant two's fixations during the movements in the dressage test for all three horses.





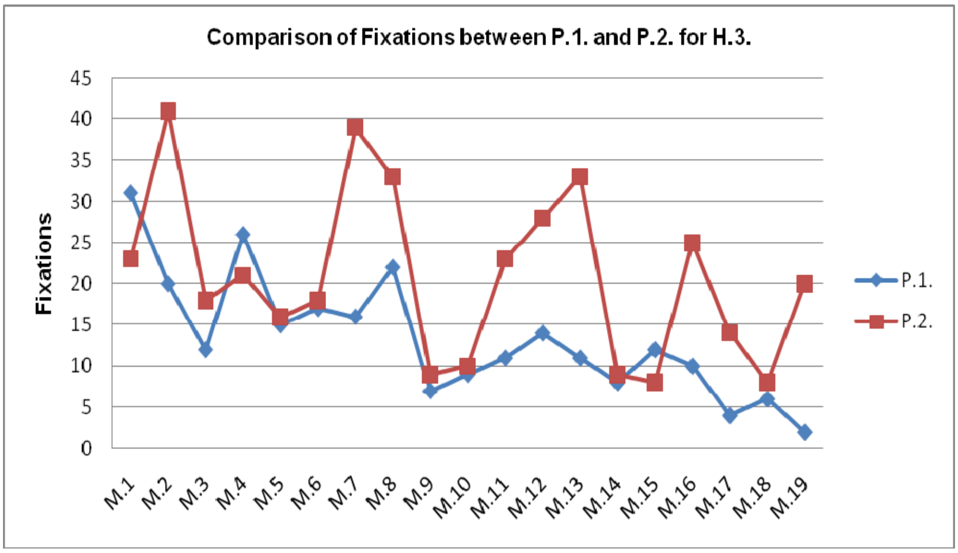
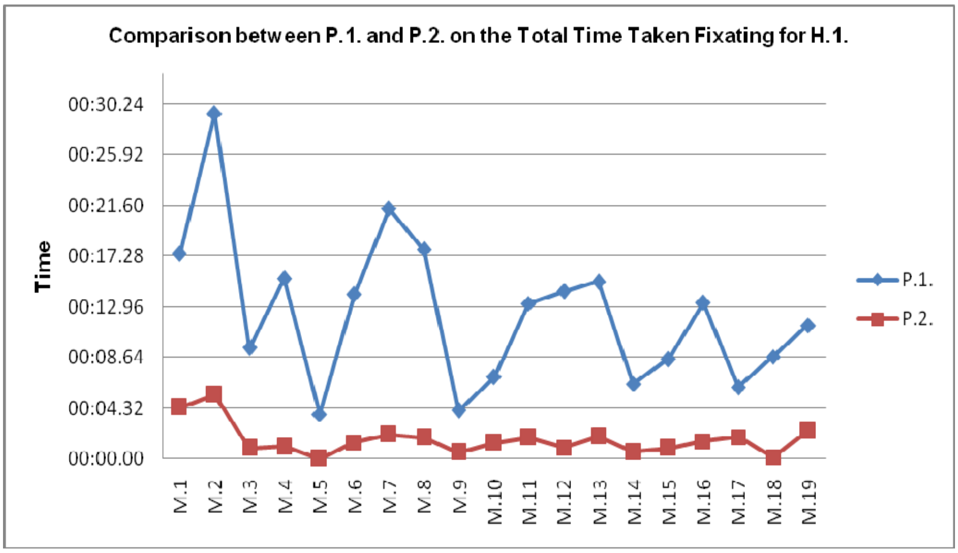


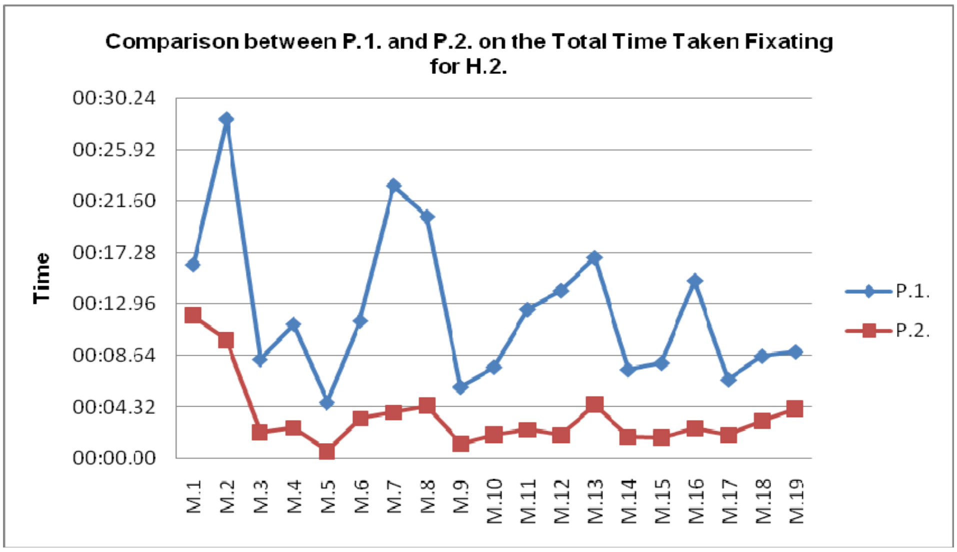
Figure 4.10: Comparison of Fixations between P.1. and P.2.

The graph clearly shows that there is similarities in the pattern of they're fixations and also that participant two is making fewer fixations during the majority of the movements. The second graph shows the next comparison between the number of fixations made during the movements in the test for horse two. This graph actually shows a stronger similarity between the two experts with the number of fixations increasing and decreasing in a similar pattern during the movements. The number of fixations made by both participants are also closer than those made during the first dressage test.

The final comparison made on the number of fixations between participant one and two is shown in the third graph. This graph shows a role reversal during this dressage test compared to the first test, showing participant one to have made fewer fixations than that of participant two. The graph also shows that the increase in the number of fixations from movement to movement was not as much for participant one compared firstly to participant two and also to the other two dressage tests.

The next comparison was to compare the total time taken fixating during the movements of the dressage tests between the expert judge and the expert coach. Figure 4.11 shows the comparison for the three horses and graph one illustrates no similarity between the two participants during the dressage test for horse one. Unusually, the expert judge illustrates a lower amount of time fixating than would be expected. It would also be expected that the amount of time taken fixating would be similar between the judge and the coach.





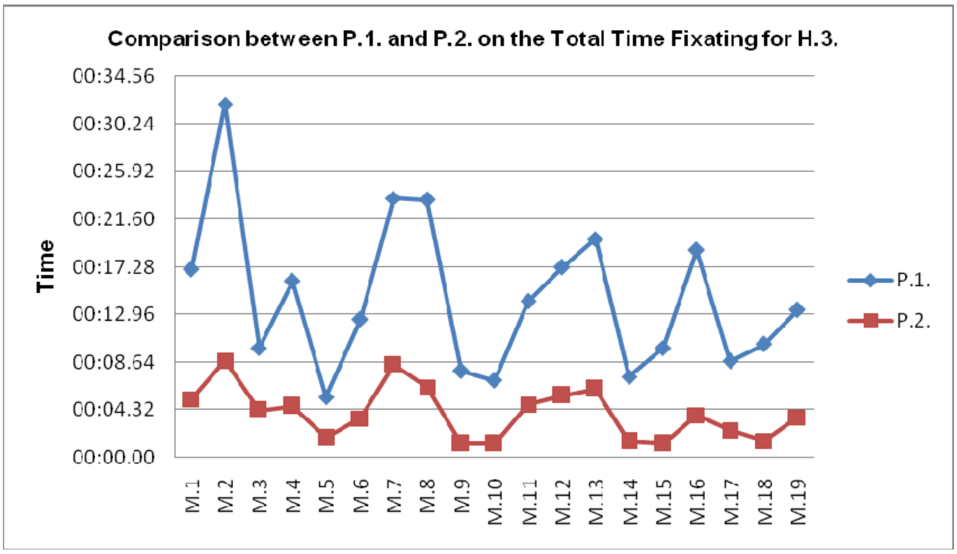


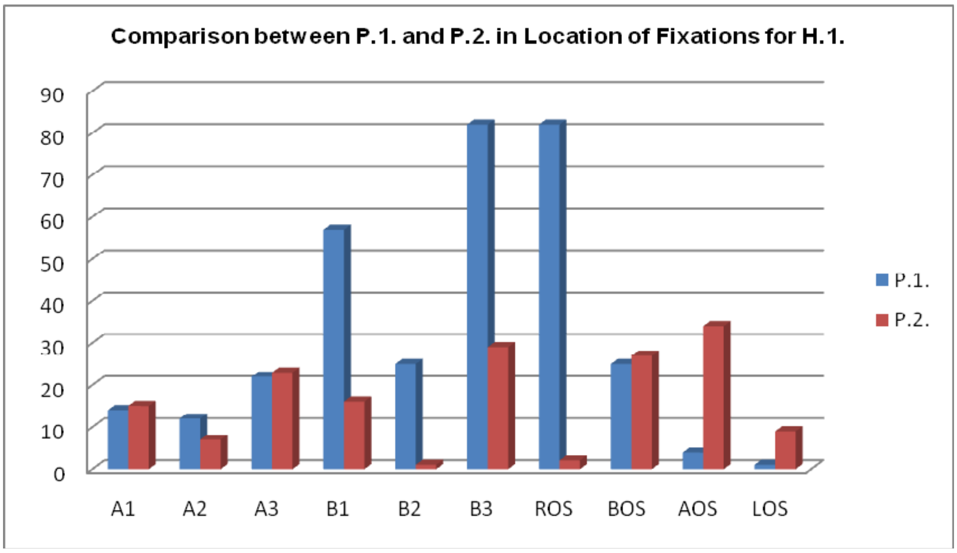
Figure 4.11: Comparison of Total Time Taken between P.1. and P.2.

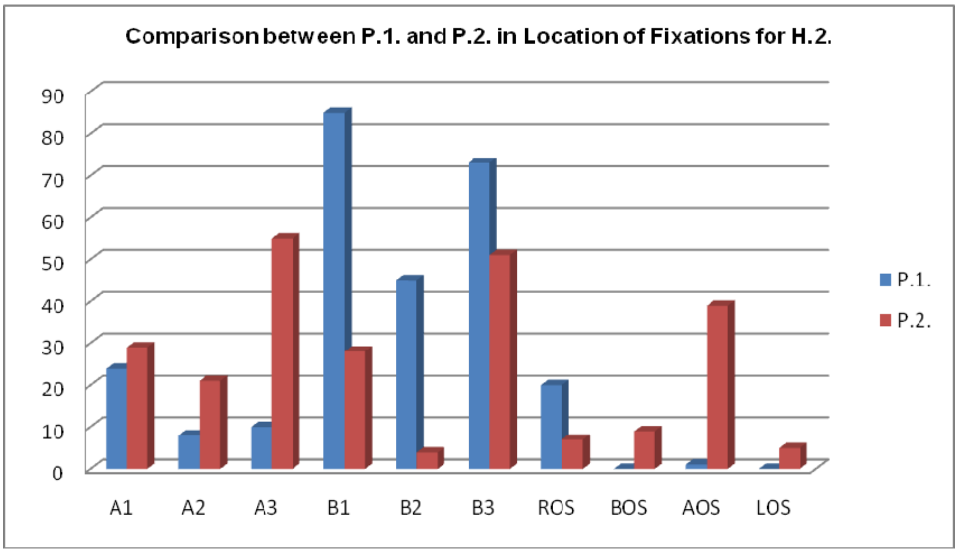
The second graph shows the comparison for horse two, which is basically identical to the results found for horse one. The comparison for horse three is shown in the next graph and it illustrates a slight similarity in the increases and decreases in time across the movements between the two participants. There is still a difference between the total time taken, which could suggest that the elite judge has already made the decision and therefore does not need to fixate on the desired location for as long as the coach does.

Figure 4.12 illustrates the comparison between the location of where the participants are fixating for all three horses. The first graph illustrates that the majority of participant one's fixations were located at areas B1 (below the mid line behind the horse), B3 (below the mid line in front of the horse) and ROS (on the right handsie outside of the screen). Whereas,the majority of participant two's fixations were located in areas A3 (above the mid line in front of the horse), B3 (below the mid line in front of the horse), BOS (below outside the screen) and AOS (above outside the screen). This shows that there are some similarities between the two participants as they both fixate more in the area's below the mid-centre of the horse.

The second and third graph follow a similar pattern to graph one but also show that participant two fixates considerably on areas A1 (above the mid line behind the horse), A2 (above the mid line in the centre of the horse) and A3 (above the mid line in front of the horse) compared to participant one. Even though there is this difference participant two also fixates on areas B1(below the mid line behind the horse) and B3 (below the mid line in front of the horse) which are similar locations to participant one.

These graphs suggest that the elite judge and coach do fixate in the same location but also the judge fixates more in other areas than the coach. This can help develop training and coaching for the coach as they can be trained to look where judges are looking and also coach riders more efficiently if they know where the judges will be looking during certain movements of the dressage test.





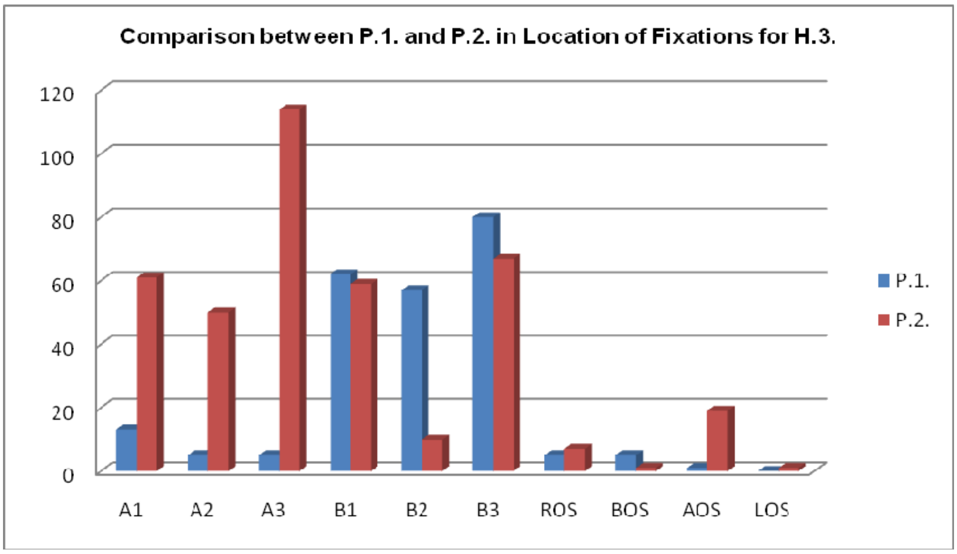


Figure 4.12: Comparison of Fixation Locations between P.1. and P.2.

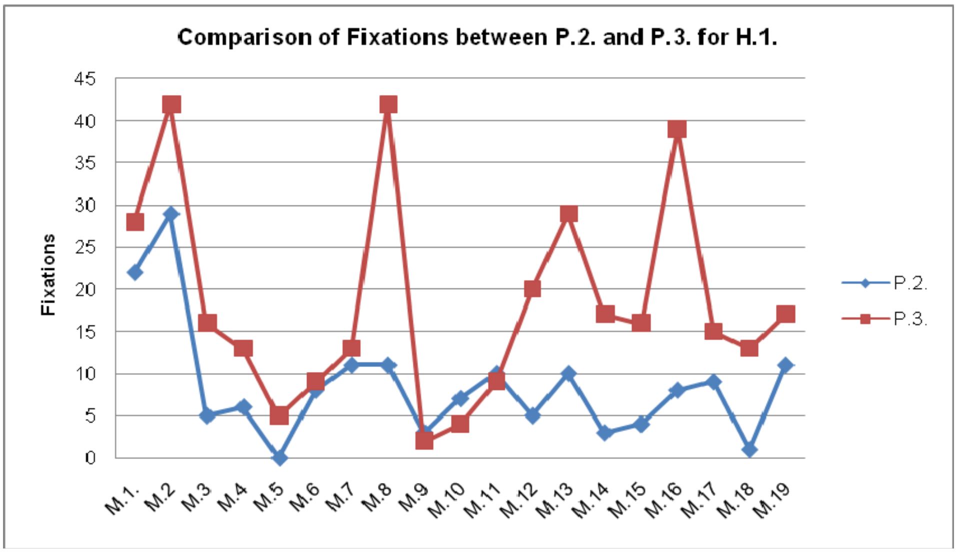
4.5. Comparison of Fixations between Participant two (Expert Judge) and three (Novice Judge):

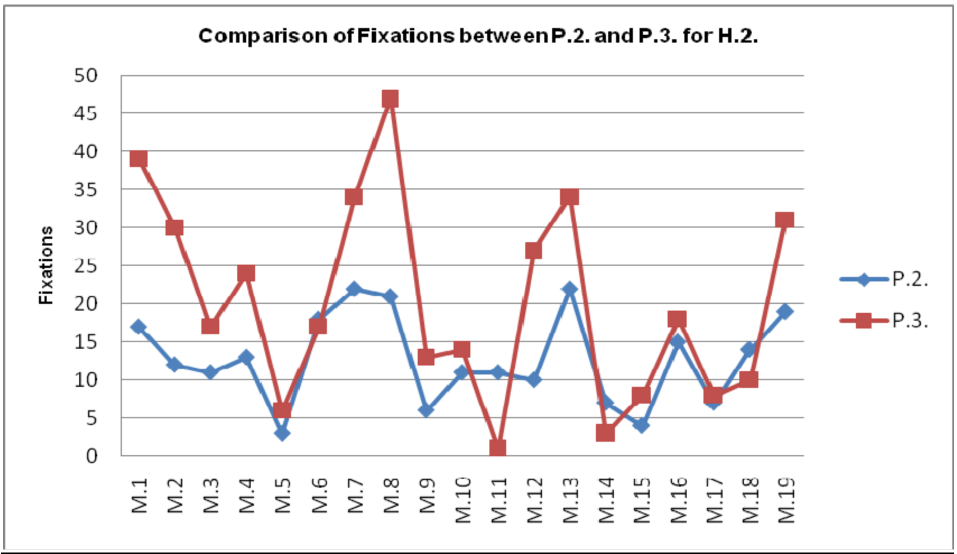
Participant three who was the novice had their number of fixations, total time of fixations and location of fixations compared against the expert judge participant two.

Figure 4.13 displays the results for the comparison between participant two and participant three for the number of fixations made during the movements in each of the three dressage tests. As expected participant three clearly illustrates a higher number of fixations made during the movements for horse one and two. This demonstrates that compared to the expert judge, participant three (the novice) is fixating more times during the majority of the movements in the dressage test.

For example during movement eight participant two makes a total of eleven fixations for horse one and twenty one fixations for horse two, whereas, participant three makes a total number of forty two for horse one and forty seven for horse two. For horse one the comparison in the number of fixations during movement eight is nearly four times the difference and for horse two it is more the double the difference.

However, during the dressage test for horse three the number of fixations for participant three have decreased and the pattern between the two participants is beginning to illustrate similarities.





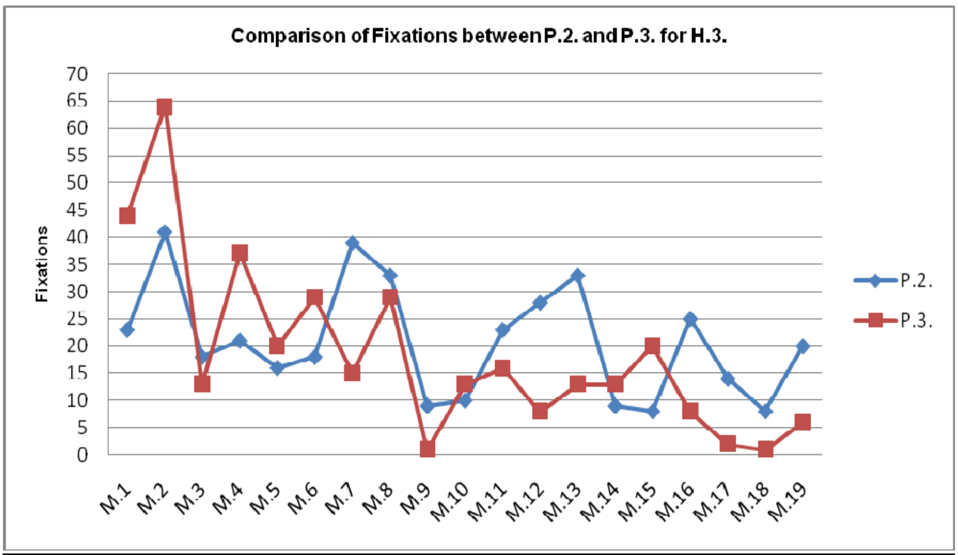
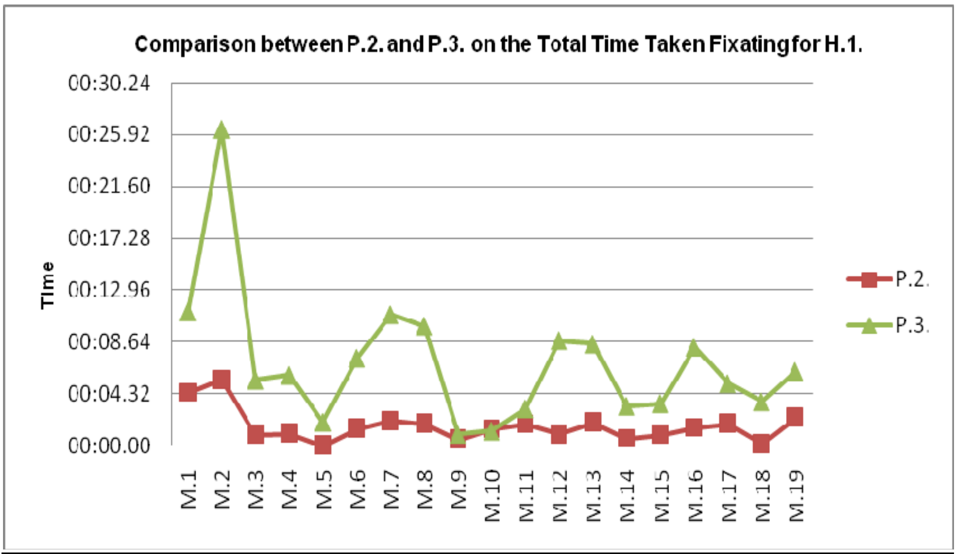


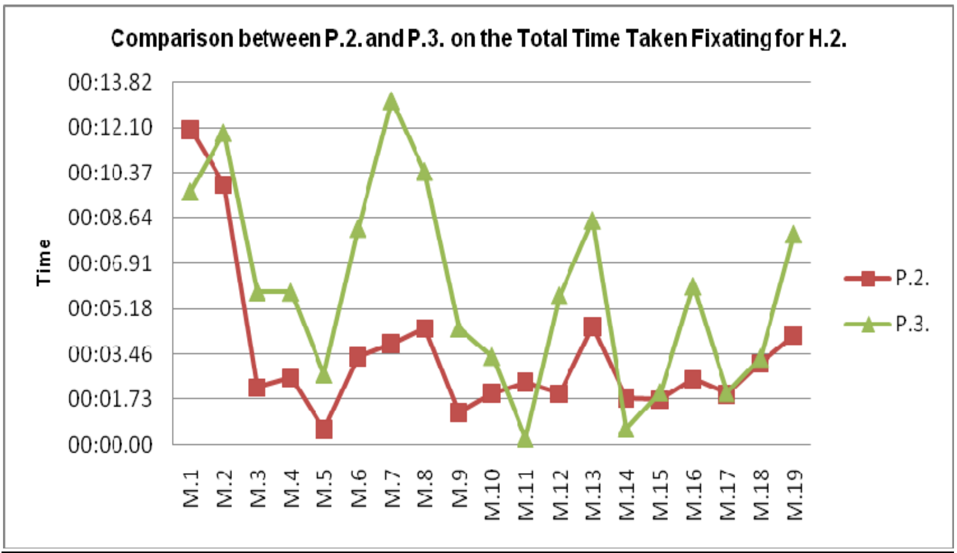
Figure 4.13: Comparison of the Number of Fixations between P.2. and P.3.

Figure 4.14 shows the comparison made between participants two and three on the total time fixating for the three dressage tests. Graph one illustrates the opposite to what would be expected. The graph shows that participant three actually spends more time fixating during the majority of the movements throughout the dressage test than the expert judge. Normally we would expect the expert judge to have fewer fixations but to fixate for longer than that of a novice.

Graph two illustrates the same as graph one with participant three fixating for longer, however, participant two seems to be increasing the time fixating during the movements for the second dressage test.

Graph three shows the comparison for the third dressage test and this reveals that the two participants have developed a similar pattern. The graph also shows that participant two has now begun to fixate for longer in certain movements. For example, in movements seven, twelve and sixteen to nineteen, participant two spent more time fixating than the novice participant.





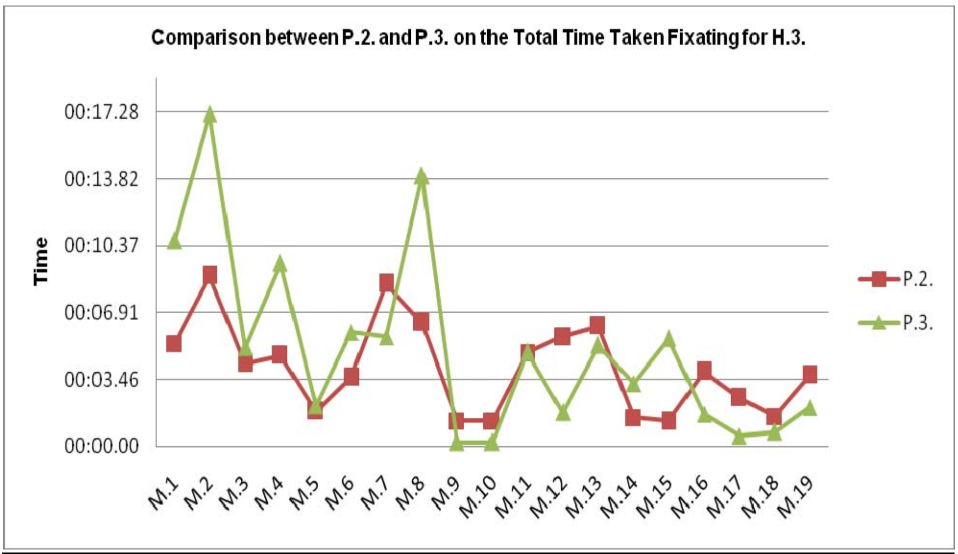
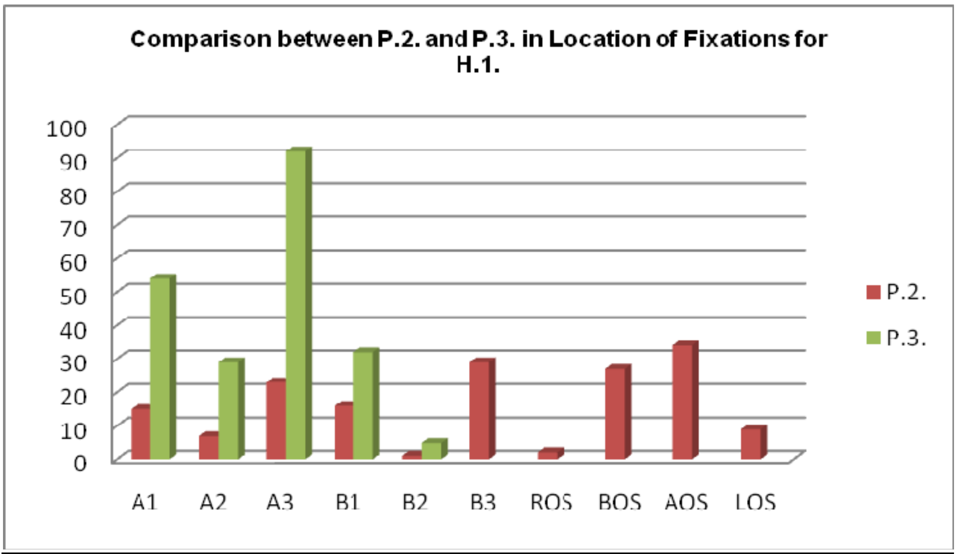


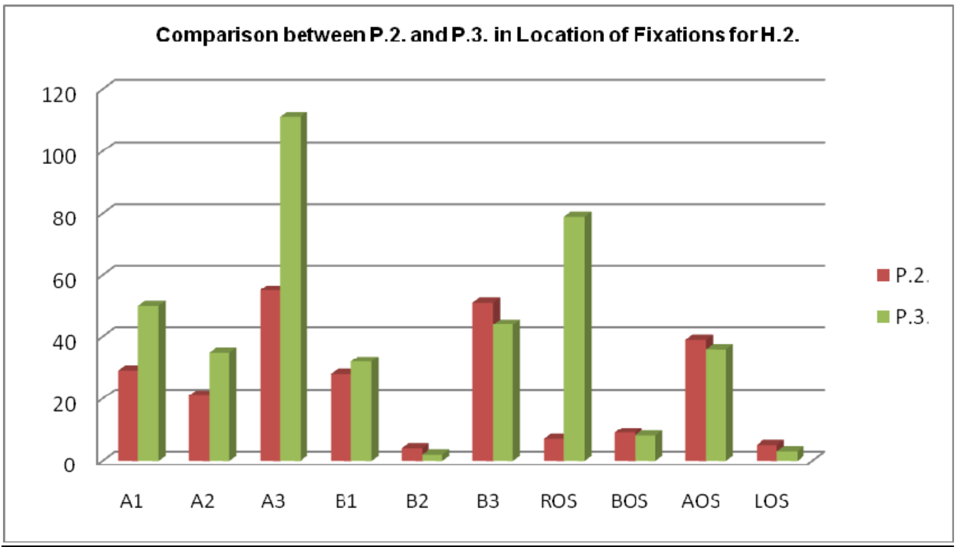
Figure 4.14: Comparison of Total Time Taken between P.2. and P.3.

The final comparison between the two participants was on the location of where they were fixating during the dressage tests. Figure 4.15 illustates the number of times participants two and three located in each area during each dressage test. Graph one shows that the novice participant mainly fixated in areas A1 (above the mid line behind the horse) and A3 (above the mid line in front of the horse) compared to participant two who mainly fixated in area AOS (above outside of the screen), BOS (below outside of the screen) and B3 (below the mid line in front of the horse). This illustrates that the two participants have a diverse visual pattern when they are judging the first dressage test. The pattern is so diverse as the novice participant did not make one single fixation in any of those areas and also only fixated in five of the areas compared to the expert judge who fixated in all ten areas.

Graph two shows the opposite to graph one as the novice participant actually fixated in all ten locations. The similarity between the two participants is participant two locates mainly in locations B3 (below the mid line in front of the horse) and A3 (above the mid line in front of the horse) and these are two of the novices main locations.

Graph three illustrates again a further progression in the similarity between the two participants. A3 (above the mid line in front of the horse) is the location where both participants fixated the most. This has been the same for the novice participant throughout the three dressage tests but this has changed for the expert judge. The graph also shows a pattern between where both participants have fixated and the amount of times they have fixated in those locations.





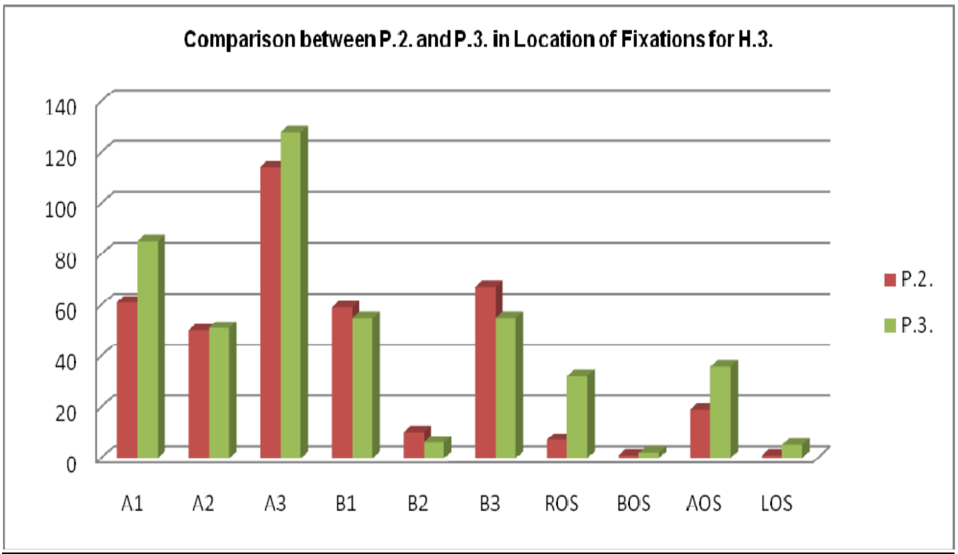


Figure 4.15: Comparison of Location of Fixations between P.2. and P.3.

5. Discussion:

The purpose of this research project was to compare the visual scan patterns between an expert judge, an expert coach and a novice judge. This would then hopefully lead to identifying any similarities and differences and also highlight where expert judges are fixating, which in turn would help develop future training for athletes and coaches. This is important especially in sports that are judged as one mark can be the difference between winning and being the runner up. Therefore, every advantage is important and if a coach and athlete know where judges look in certain movements of a dressage test this could enhance their training sessions to ensure that they are not only adhering to what the judge will be looking for but also to where and when.

The current research project is part of a small number that have investigated and compared the similarities and differences in the visual scan patterns between two types of expert and a novice (e.g., Canal-Bruland et al, 2012; Hancock & Ste-Marie, 2013; Jarodzka et al, 2010 & Memmert et al, 2009). This therefore provided another purpose to this research project which was to present recommendations and ideas that could be implemented by sport psychologists when working with both elite riders and elite coaches.

After examining the results from this research project it was found that the hypotheses were partly supported. The novice judge made a higher number of fixations compared to the expert judge and the expert judge and expert coach had similarities within their scan patterns. However, the time taken fixating did not support the hypothesis as the results showed that both the expert coach and the novice judge fixated for longer compared to the expert judge.

5.1. Visual Scan Pattern of the Expert Coach:

The expert coach demonstrated a consistent pattern for the duration of fixations for the three dressage tests, which is clearly seen in figure 4.2. This shows consistency in the amount of time the coach needs to fixate to gain the required information to make their decision. These results support previous research such as Mann et al (2007), Morgan and Patterson (2009), Raab and Johnson (2007) and Williams et al. (1999) who indicate that experts selectively attend to only the most relevant sources of information within the environment to inform their decisions and consequently their behaviour. These results illustrate that the expert coach is able to categorise the information in the visual field (Bundesen, 1990) and employs the common metaphor known as a spot light (Treisman, 1982). The spot light of attention highlights an area in the environment that is of greater relevance to the coach and filters out anything outside of the spotlight which is not relevant resulting in a decision being made on the movement (Deco et al, 2002).

The number of fixations, shown in figure 4.1, revealed similarities across the three dressage tests. However, during the third test the coach had fewer fixations but still maintained the duration time. This has also be seen in the study by Hernandez et al (2006) who found that during their second test the coaches from both their groups had a lower number of fixations compared to their first test. This links to the theory that experts make fewer fixations and their fixation time is for a longer duration (Williams et al., 1999 & Mann et al., 2007). This longer fixation period is described by Vickers (1996) as the quiet eye period with the concept that experts demonstrate this extended period of time. This extended period of time can be explained by Bless et al's. (2004) sequence of social information processing seen in figure 2.1. The social cognitive perspective can help explain how the expert coach has made fewer fixations and managed to be so consistent in the fixation duration. When the coach is fixating on a specific point they are involved in decision making which involves their prior knowledge of dressage and of experiencing dressage competitions. This allows for the coach to be able to efficiently categorise and assess the relevant movement that has been perceived to make the decision on the mark given. This process results in the expert coach decreasing the number of fixations they make and maintaining the long duration of their fixations. Hernandez et al (2006), further identified that the decrease in the number of visual fixations in a real world situation may be consistent with the Treisman's theory (Treisman, 1988), who suggests that we initially recognise objects on the foundation of their sensory features. Therefore, as an expert coach they should be familiarized with live conditions resulting in quicker identification of errors by the dressage rider and therefore a reduced number of visual fixations (Hernandez et al, 2006).

The locations of the fixations predominantly were in the areas below the midline, either in front of or behind the horse. This suggests that as an expert coach it is within these areas and the peripheral span where they focused their attention to gain the required information during the three dressage tests. Therefore, the coach's main registered fixation locations are in front or behind the horse which then asks the question how much information they are extracting from these specific locations.

Hagemann et al. (2010) explain by shifting attention it is possible to fixate in one location, i.e. the coach fixates in B3 in front of the horse, while extracting relevant information from the neighbouring locations in the periphery, i.e. the position of the riders hands. Hagemann et al. (2010) and Savelsbergh et al. (2002) also suggest that it is unknown how much information is not only picked up through the fovea but also the peripheral regions of the retina and through the parafoveal. This is an area of research that could be of interest in the future due to the implications that could occur. For example, a coach may use a multiple of sources to pick up information from a training point of view. If the coach is watching their rider perform in a dressage test then they will be looking at how they perform certain movements the same as a judge but also they will have the knowledge of how the rider performs and what movements they have difficulties with. Therefore, the coach may look for other sources within the environment i.e. looking at the rider and their positioning as well as taking in the peripheral information of how the horse is positioned.

The results suggest that the experience the expert coach has gained has assisted them in attaining some of the characteristics of an experts visual scan pattern.

5.2. Visual Scan Pattern of the Expert Judge:

As expected the expert judge displayed a consistent visual scan pattern in the number of fixations and the duration of fixations across all the dressage tests. This shows that the visual scan pattern of the expert judge does not change throughout the tests suggesting that the expert judge is fixating on the relevant locations to gain the required information.

However, even though the number of fixations (shown in figure 4.4) followed a consistent visual pattern there were still differences between the number of fixations for horses one and two compared to horse three where the number of fixations increased during certain movements within the dressage test. These increases are clearly shown in movements two, seven, eight, thirteen and sixteen in figure 4.4. Even though the peaks follow the visual pattern in the other two dressage tests, the volume of the increase is inconsistent with previous research which found experts to make fewer fixations (e.g., Canal-Bruland et al, 2012; Moreno et al, 2002 & Hernandez et al, 2006).

However, these findings are corroborated in the studies by Goulet et al. (1989), Moran et al. (2002), Page (2009), Williams and Davids (1998), Williams and Elliot (1999), and Williams et al. (1994) who found that experts made a higher number of fixations when completing a variety of tasks. Page (2009) also stated that the increased number of fixations was required by the expert gymnastic judge to produce a coherent representation of the visual display. This could describe the increase in fixations by the expert dressage judge and can be explained through the varying degrees of perceptual (i.e. the speed, noise or colour of the display) and by the amount of decision making required during each movement (i.e. certain movements within the dressage test involve more complex tasks compared to other movements) (Page, 2009). Therefore, Page (2009) states that different tasks require different numbers of fixations for a judge to be able to obtain the required information from the visual display to make their decision.

The graph in figure 4.5 shows that the duration times of the fixations seem lower than expected when compared to previous research that found experts fixated for a longer duration (e.g., Canal-Bruland et al., 2012; Goulet et al, 1989; Helsen & Pauwels, 1993; Moreno et al., 2002 & Rippoll et al., 1995). However, this could be due to the expert judge fixating, locating and making a decision in that specific time frame ready for the next sequence. Wu et al. (2013) describe how elite performers require cognitive factors such as past experience and development to incorporate all the information integrated within visual perception. This could suggest that as an expert judge the past experience has been acquired to be able to process the environment efficiently to then be able to filter the information needed quickly to move on to judging the next sequence. This time pressure is a constraint put onto the judge to mark each continuous movement quickly and efficiently (Plessner & Haar, 2006). Therefore, the expert judge uses the bottom –

up and top – down processes to direct their attention to the desired locations within the visual field (Wolfe, 2002). The information integration step of the social information processing sequence, shown in figure 2.1, is where the expert judge uses their prior knowledge combined with categorising the specific dressage movement to make their decision on the mark given. This explains how the judge is able to fixate for a shorter duration due to them using past knowledge and experiences to make their judgment quickly due to the constraint of time. This could link with the research done by Martell and Vickers (2004) who found that the elite athletes directed their fixations over a short duration to specific locations in the environment as the play developed and they had a longer duration of fixations on a relatively stable location or stimuli.

The location of where the expert judge was fixating was predominantly above the mid-line in the area in front of the horse (A3) and below the mid-line also in the area in front of the horse (B3) (shown in table 4.2). This suggests that the expert judge is predominantly looking to the next step and the next move and could be processing the peripheral information from these locations by shifting their attention as suggested in the research by Hagemann et al (2010). These findings also suggest that through prior knowledge and experience the expert judge is anticipating what will happen whilst scoring the dressage movement so they move their focus ahead of the action. This supports the research findings of Page (2009) who found that gymnastic judges predominantly fixated in front of the gymnasts. These results also support previous findings that an expert posse's extensive procedural and declarative knowledge and are more proficient at decision making enabling them to extract the important information from the environment to anticipate and predict future outcomes and events (French & Thomas, 1987; French, Spurgeon, & Nevett, 1995; Holyoak, 1991; McPherson, 1999, 2000; Williams et al, 1999).

These findings are consistent and inconsistent with previous research and show that the dynamic nature of judging requires an expert judge to be able to locate and process the required information within the visual display under a time constraint before a decision can be made.

5.3. Visual Scan Pattern of the Novice Judge:

The novice judge showed an inconsistent number of fixations over the movements in all three dressage tests. This supports previous research by Hagemann et al. (2010), Mann et al. (2007) and Williams et al. (1999) suggesting that a novice's visual scan pattern is not as accurate as an expert and this is partially due to an increased number of fixations which is caused by not having the experience to know what the environmental visual cues are. Therefore, suggesting that the novice judge does not have the experience to be able to perceive the required stimuli to fixate on the appropriate location. If we look at Bless et al. (2004) social information processing model (figure 2.1), which shows that prior experience and knowledge is an essential part of the information process (Plessner & Haar, 2006). For example, for the novice judge to be able to categorise and make an informed decision they need to be able to retrieve the judging criteria of the movements within the dressage test from memory (Plessner & Haar, 2006). Therefore, with less experience they will have a reduced amount of knowledge of what stimuli to locate and fixate on increasing the number of fixations.

There was a clear and consistent pattern in the duration of the fixations, showing that the amount of time decreased throughout the movements for all three dressage tests (seen in figure 4.8). These findings contradict a number of research studies including Moreno et al. (2002), Page (2009), Ripoll et al. (1995), and Savelsbergh et al. (2002).

Therefore, this pattern could suggest that the novice judge is recognising specific environmental cues during each movement to allow their duration pattern to be similar throughout and may have prior knowledge and experiences of dressage tests. They may be novice within a judging status, however, have been involved in dressage and are aware of certain stimuli to focus on. This could explain why their fixations are high due to lack of experience within judging, however, are consistent with their duration when fixating as they are able to recognise certain stimuli from previous dressage experiences.

The locations of the fixations, shown in figure 4.9 and table 4.3, reveal that during the first test the novice judge only fixated over five points, which were either above the mid line (A1, A2 and A3) or below the mid line (B1 and B2). However, test two and three show the opposite where the novice judge fixated on all locations. The results for test two and three are supported by Page (2009), Savelsbergh et al. (2002), and Wu et al. (2013) who found that their novice participants shifted their fixations across the locations of interest. Wu et al. (2013) states that due to novices having less experience in the sport and are unable to identify the required information from the locations this results in a lower duration time and an increased scan ratio.

The locations where the novice judge fixated the most during test two and three were in front of the horse above the mid line (A3) and behind the horse above the mid line (A1), as seen in figure 4.9. The other locations that had a similar number of fixations included above the mid line in the middle of the horse (A2), behind the horse below the mid line (B1), in front of the horse below the mid line (B3) and outside of the screen on the right hand side (ROS), which can be either in front, behind or at the side of the horse depending on the movement being performed. These findings further support previous research suggesting that novices' shift their gaze fixations among the locations of interest and search for information from less sophisticated sources within the environment (Casanova et al. 2009, and Wu et al., 2013).

These research findings have supported and also contradicted previous findings, suggesting that the novice judge may be new to the judging aspect of dressage but have prior experience and knowledge within the sport of dressage in a different role.

5.4. Comparison:

When comparing the visual scan pattern of the expert judge to the expert coach there were expected similarities that emerged and also unexpected differences. The number of fixations showed a similarity during dressage test two but a role reversal of the expert judge having made fewer fixations in dressage test one to more fixations in dressage test three. This could suggest that both experts have a similar visual search pattern which supports previous research by Catteuw et al (2009) and Hancock and Ste-Marie (2013) that looked at the gaze patterns of different levels of expert referees.

Hancock and Ste-Marie (2013) found that higher level and lower level ice hockey referees did not differ on gaze behaviours, however, the higher level referees were superior on decision making because they were able to process the relevant information more effectively. This could suggest that the two experts have the relevant prior knowledge of dressage to be able to fixate upon the relevant information (Bless et al. 2004). However, the expert judge has the required knowledge and experience as a judge to be able to make decisions more effectively compared to the expert coach.

As expected the novice judge made an increased number of fixations compared to the expert judge. This supports previous research and the theory that a visual search strategy that involves fewer fixations is perceived as more efficient (Canal-Bruland et al. 2012, Williams et al. 1999 & Mann et al. 2007). This further supports Bless et al. (2004)

social cognition perspective which highlights the reliance on prior knowledge to be able to encode and categorise the stimulus. For example, the expert judge has the relevant prior knowledge that has been stored in their long term memory and therefore allows them to recognise the relevant stimulus, encode and categorise it to then make the relevant decision on what mark to award. Compare this to the novice judge who has less experience and less prior knowledge to be able to recognise the relevant stimulus resulting in a greater number of fixations.

The expert judge’s duration of fixations was less than the expert coach and the novice judge which was unexpected. This supports the research of Williams and Davids (1998) and Williams et al. (1994) who found that experts in soccer generated shorter fixations than novices. However, this could suggest that the expert judge could have picked up earlier advanced information than the other two participants. These findings support the research by Abernethy and Russell (1987) who found expert badminton players able to pick up advanced information earlier than novice players.

Page (2009) suggests that the requirements for the duration of fixations are task specific. In the judging of specific gymnastic skills Page (2009) states these specific skills require fixations for a longer duration. This is also supported by Moreno et al. (2002) who found expert coaches produced longer fixation durations compared to inexperienced coaches. However, within dressage the specific skills that have to be observed and judged are completely different to those of a gymnastic skill. For example, a vault in gymnastics consists of approximately a few seconds, whereas, a dressage test is over a period of six minutes and includes a number of movements that vary in complexity. Therefore, it could be suggested that the duration of fixations are task specific and the task requires the judge to make decisions quickly before moving onto the next movement resulting in the duration of the fixations decreasing.

The location of where the expert judge and the expert coach are looking shows similarities and also shows that the expert judge is locating their fixations in other areas (shown in figure 4.12). During all three dressage tests the coach predominantly located their fixations below the mid line in front of the horse (B3), below the mid line behind the horse (B1) and in the centre of the horse below the mid line (B2). This suggests that the main locations that the expert coach fixates upon when judging a dressage test is predominantly below the mid line. In comparison the expert judge who located their fixations predominantly above the mid line in front of the horse (A3) and below the mid line in front of the horse (B3) during the three dressage tests. This suggests and supports research by Page (2009) that the expert judge locates their fixations primarily in front of the horse ready to anticipate what will happen in the next movement.

The locations of where the expert judge is fixating could be identified to the expert coach and be a valuable training tool for when they are coaching dressage riders. This information would increase their knowledge and be stored in their long term memory, which according to Bless et al. (2004) sequence of social information processing is essential for the coach to be able to categorise, assess and produce a response. For example, during a training session this prior knowledge could now be used to assess the movement the rider is practising and allow them to process this information differently than they would have previously knowing that the expert judge will continually be looking ahead of the horse and anticipating the next sequence of movements.

The novice judge shows the complete opposite locations of fixations compared to the expert judge during the first test but does begin to show some similarities during test two and three (shown in figure 4.15). It is clear that during the second and third tests the location that was fixated on the most by the expert judge and the novice judge was above the mid line in front of the horse (A3). This is inconsistent with previous research by Jarodzka et al. (2010); Ripoll et al. (1995); Vickers (1992); Williams et al. (1994); and Wu et al. (2013) whose results found that experts showed systematic differences in their location of fixations. However, research by Hernandez et al. (2006) found that elite and novice tennis coaches both made the highest number of fixations on the same location. This could suggest that the novice judge in the current study and the novice coach in the study by Hernandez et al. (2006) are categorised as novice within the judging of dressage and the coaching of tennis but could have gained valuable knowledge and experience within the sport at an elite standard by competing. This is an area that could be explored in the future as according to Bless et al. (2004) knowledge and experience are the valuable factors that inform our decisions, therefore, the prior experiences within their sport for coaches and judges at any level need to be taken into account.

In summary, the findings revealed that the expert coach and judge showed similarities in their visual search patterns and also revealed differences which could be applied to give coaches further information and knowledge when coaching dressage riders.

As expected the novice judge made a higher number of fixations compared to the expert judge, however, the expert judge fixated for a shorter duration. This suggests that the expert judge is more efficient at processing information and decision making. The study found the novice judge and the expert judge located their fixations in the same main area above the mid line in front of the horse (A3). This highlights that previous experiences and knowledge of the sport need to be highlighted and taken into consideration when researching visual scan patterns. For example a novice judge is classified by their qualifications, however, an experienced competitor who has competed in dressage at an elite level and then decides to go into judging later on in their career has a completely different knowledge base in their long term memory compared to a novice judge who is new to the sport of dressage. Therefore future research should take into account the experiences within the sport and not just the classification of a judge, coach or official. Also, further research is needed to investigate if there is a difference between elite judges and not just to compare them to novices. This could provide further in depth information to coaches and riders of what essential areas judges locate and fixate on when judging dressage tests.

6. Conclusion:

This research aimed to identify the visual search patterns of an expert coach and a novice judge in comparison of the visual search pattern of an elite judge in the sport of dressage. The expert coach and judge showed similarities in the number of fixations made in the three dressage tests and as expected the expert judge made fewer fixations compared to the novice judge. However, the expert judge fixated for a shorter duration of time compared to both the expert coach and the novice judge which was unexpected. The locations of fixations revealed similarities between the expert coach and the expert judge and therefore provided further research into the comparison between expert judges and coaches and how a training plan could be developed to provide coaches with the knowledge to develop and train their riders more effectively. Another area for future research was also identified when comparing the locations of fixations between the expert and novice judge. The novice and expert judge fixated on the same location A3 the most during two of the dressage tests, which suggests that the novice judge had gained experience within the sport previously. This highlighted that experience within the sport can lead to unexpected results, for example, a novice judge could have gained years of experience as an elite competitor and may be only qualified recently as a novice judge. Therefore, this novice judge has more knowledge and experience within the sport compared to a novice judge who is new to the sport altogether. This could also look at the experiences of elite judges and comparing their visual search patterns. Their experiences can also vary by the number of years they have been judging and also if they have gained experience as a rider or coach previously. Furthermore, future research could compare a group of elite classified judges that all have different levels of knowledge and experience against one another to see if there are any differences between their visual search patterns.

7. References:

Abernethy, B. (1991). Visual Search Strategies and Decision-Making in Sport. *International Journal of Sport Psychology, 22,* 189-210.

Abernethy, B. (2001). Attention. In R. N. Singer, H. A., Hausenblas, & C. M. Janelle (Eds). *Handbook of sport psychology* (pp. 53-85). New York: Wiley.

Abernethy, B., & Russell, D. G. (1983). Skill in tennis: Considerations for talent identification and self development. *Australian Journal of Sport Sciences, 3(1),* 3-12.

Abernethy, B., & Russell, D. G. (1987). Expert-novice differences in an applied selective attention task. *Journal of Sport Psychology, 9,* 326-345.

Al-Abodod, S., Bennett, S. J., Hernandez, F. M., Ashford, D., & Davids, K. (2002). Effect of verbal instructions and image size on visual search strategies in basketball free throw shooting. *Journal of Sports Sciences, 20,* 271-278.

Abrams, R. A., Meyer, D. E., & Kornblum, S. (1989). Speed and accuracy of saccadic eye movements: Characteristics of impulse variability in the oculomolor system. *Journal of Experimental Psychology: Human Perception and Performance, 15,* 529-543.

Bard, C., & Fleury, M. (1981). Considering eye movement as a predictor of attainment. In I. M. Cockerill, & W. M. MacGillvary (Eds.), *Vision and Sport* (pp. 28-41). Cheltenham, UK: Stanley Thornes Ltd.

Bar-Eli, M., & Raab, M. (2006). Judgement and decision making in sport and exercise: Rediscovering and new visions. *Psychology of Sport and Exercise, 7,* 519-524.

Bless, H., Fiedler, K., & Strack, F. (2004). *Social cognition – How individuals construct social reality.* New York: Psychology Press.

Boen, F., Auweele, Y. V., Claes, E., Feys, J., & Cuyper, B. D. (2006). The impact of open feedback on conformity among judges in rope skipping. *Psychology of Sport and Exercise, 7,* 577-590.

Broadbent, D. E. (1961). *Perception and Communication.* London: Scientific Book Guild.

Bryan, A. J. (1987). Single-subject designs for evaluation of sport psychology interventions. *The Sport Psychologist, 1,* 283-292.

Bundesen, C. (1990). A Theory of Visual Attention. *Psychological Review, 97(4),* 523-547.

Bjorklund, R. (2010). *The Amazing Human Body: The Senses.* New York: Marshall Cavendish Benchmark.

Canal-Bruland, R., Lotz, S., Hagemann, N., Schorer, J., & Strauss, B. (2012). Visual span and change detection in soccer: Am expertise study. *Journal of Cognitive Psychology,23(3),* 302-310.

Casanova, F., Oliveira, J, Williams, M., & Garganta, J. (2009). Expertise and perceptual-cognitive performance in soccer: a review. *Revista Portuguesa de Ciencias do Desporto, 9(1),* 115-122.

Cereatti, L., Casella, R., Manganelli, M., & Pesce, C. (2009). Visual attention in adolescents: Facilitating effects of sport expertise and acute physical exercise. *Psychology of Sport and Exercise, 10,* 136-145.

Chelazzi, L., Duncan, J., Miller, E. K., & Desimone, R. (1998). Responses of neurons in inferior temporal cortex during memory guided visual search. *The American Physiological Society.*

Chelladurai, P., & Turner, B. A. (2006). Styles of decision making in coaching. In. J. M. Williams(Eds.), *Applied Sport Psychology: Personal Growth to Peak Performance.* New York: McGraw Hill.

Cote, J., Salmela, J.H., Trudel, P., Baria, A., & Russel, S. (1995). The coaching model: A grounded assessment of expert gymnastic coaches' knowledge. *Journal of Sport and Exercise Psychology, 17,* 1-17.

Deco, G., Pollatos, O., & Zihl, J. (2002). The time course of selective visual attention: theory and experiments. *Vision Research, 42,* 2925-2945.

Ericsson, K. A., & Smith, J. (1991). Prospects and Limits of the empirical study of expertise: An Introduction. In K. A. Ericsson, & J. Smith (Eds.), *Towards a general theory of expertise: Prospects and limits.* (pp. 1-29). Cambridge: Cambridge University Press.

Evans, R., & Franklin, A. (2010). Equine Beats: Unique Rhythms (and Floating Harmony) of Horses and their Riders. *Geographies of Rhythm*, 173-188.

Fairchild, M. D., Johnson, G. M., Babcock, J., & Pelz, J. B. (2001). *Is Your Eye on the Ball?: Eye Tracking Golfers while Putting.* Unpublished Manuscript, Rochester Institute of Technology.

French, K. E., Spurgeon, J. H., & Nevett, M. E. (1995). Expert-novice differences in cognitive and skill execution components of youth baseball performance. *research Quarterly for Exercise and Sport, 66(3),* 194-201.

French, K. E., & Thomas, J. R. (1987). The relation of knowledge development to children's basketball performance. *Journal of Sport Psychology, 9,* 15-32.

Gilovich, T. (1984). *Judgemental biases in the world of sport.* In W. F. Straub, & J. M. Williams (Eds.), *Cognitive Sport Psychology* (pp. 31-41). Lansing, MI: Sport Science.

Glencross, D. J., & Cibich, B. J. (1977). A decision analysis of games skills. *Australian Journal of Sports Medicine, 9(3),* 72-75.

Goulet, C., Bard, C., & Fleury, M. (1989). Expertise differences in preparing to return a tennis serve: A visual information processing approach. *Journal of Sport & Exercise Psychology, 11,* 382-398.

Hagemann, N., Schorer, J., Canal-Bruland, R., Lotz, S., & Strauss, B. (2010). Visual perception in fencing: Do the eye movements of fencers represent their information pickup? *Attention, Perception, & Psychophysics, 72(8),* 2204-2214.

Hancock, D. J., & Ste-Marie, D. M. (2013). Gaze behaviours and decision making accuracy of higher- and lower-level ice hockey referees. *Psychology of Sport and Exercise, 14,* 66-71.

Hrycaiko, D., & Martin, G. L. (1996). Applied research studies with single-subject designs: Why so few? *Journal of Applied Sports Psychology, 8 (2),* 183-199.

Helsen, W., & Pauwels, J. M. (1993). The relationship between expertise and visual information processing in sport. In J. I. Starkes & F. Allard (Eds.), *Cognitive issues in motor expertise* (pp.109-134). Amsterdam: North-Holland.

Hernández, F. J. M., Romero, F. A., Vaillo, R. R., & Del Campo, V. L. (2006). Visual Behaviour of Tennis Coaches in a Court and Video-based Conditions. *International Journal of Sport Science, 2(2),* 29-41.

Holyoak, K. (1991). Symbolic connectionism: Toward third-generation theories of expertise. In K. A. Ericsson & J. Smith (Eds.), *Towards a general theory of expertise: Prospects and Limits* (pp. 301-336). Cambridge: Cambridge University Press.

Horowitz, T. S., & Wolfe, J. M. (1998). Visual search has no memory. *Nature.*

Ilmwold, C. H., & Hoffman, S. J. (1983). Visual recognition of a gymnastics skill by experienced and inexperienced instructors. *Research Quarterly for Exercise and Sport, 54,* 149-155.

Irwin, D. E. (1998). Lexical processing during saccadic eye movements. *Cognitive Psychology, 36,* 1-27.

Issacs, L., & Finch, A. (1983). Anticipatory timing of beginning and intermediate tennis players. *Perceptual and Motor Skills, 57,* 451-454.

Janelle, C. M. (2002). Anxiety, arousal and visual attention: a mechanistic account of performance variability. *Journal of Sports Sciences, 20,* 237-251.

Janelle, C. M., & Hillman, C. H. (2003). Current Perspectives and Critical Issues. In J. L. Starkes, & K. A. Ericsson (Eds.), *Expert Performance in Sports: Advances in Research on Sport Expertise* (pp. 20-47). USA: Human Kinetics.

Janelle, C. M., Singer, R. N., & Williams, A. M. (1999). External distraction and attentional narrowing: Visual search evidence. *Journal of Sport and Exercise Psychology, 21,* 70-91.

Jarodzka, H., Scheiter, K., Gerjets, P., Van Gog, T. (2010). In the eyes of the beholder: How experts and novices interpret dynamic stimuli. *Learning and Instruction, 20,* 146-154.

Judging and Volunteering (2013). *British Dressage.* Retrieved from http://www.britishdressage.co.uk/judging

Kasarskis, P., Stehwien, J., Hickox, J., Aretz, A., & Wickens, C. (2001). Comparison of expert and novice scan behaviours during VFR flight. *Presented at the 11th international symposium on aviation psychology, Columbus, OH: The Ohio State University.*

Kinugasa, T., Cerin, E., & Hooper, S. (2004). Single-Subject Research Designs and Data Analyses for Assessing Elite Athletes' Conditioning. *Sports Med 34, (15), p1035-1050.*

Koehler, D. J., & Harvey, N. (2004). Blackwell handbook of judgement and decision making (Eds.). Malden, MA: Blackwell.

Kowler, E. (1999). Eye movements and visual attention. In R. A. Wilson & F. C. Keil (Eds.), *The MIT Encyclopedia of the Cognitive Sciences*. (pp. 306-309). Cambridge, MA: MIT Books.

Landers, D. M. (1970). A review of research on gymnastic judging. *Journal of Health, Physical Education and Recreation, 41,* 85-88.

Magill, A. (1980). *Motor Learning: Concepts and Applications.* Iowa: C. Brown Publishers.

MacMahon, C., & Ste-Marie, D. M. (2002). Decision-Making by experienced rugby referees: Use of perceptual information and episodic memory. *Perceptual and Motor Skills, 95,* 570-572.

Mann, D. T. Y., Williams, A. M., Ward, P., & Janelle, C. M. (2007). Perceptual-Cognitive Expertise in Sport: A Meta-Analysis. *Journal of Sport and Exercise Psychology, 29,* 457-478.

Martell, S. G., & Vickers, J. N. (2004). Gaze characteristics of elite and near-elite athletes in ice hockey defensive tactics. *Human Movement Science, 22,* 689-712.

Martin, G. L., Thompson, K., & Regehr, K. (2004). Studies using single-subject designs in sport psychology: 30 years of research. *The behavior Analyst, 27 (2),* 263-280.

McLeod, B. (1991). Effects of eyerobics visual skills training on the selected performance measures of female varsity soccer players. *Perceptual and Motor Skills, 72,* 863-866.

McPherson, S. L. (1999). Tactical differences in problem representations and solutions in collegiate varsity and beginner female tennis players. *Research Quarterly for Exercise and Sport, 70(4),* 369-384.

McPherson, S. L. (2000). Expert-novice differences in planning strategies during collegiate singles tennis competition. *Journal of Sport and Exercise Psychology, 22,* 39-62.

Mecheri, S., Gillet, E., Thouvarecq, R., & Leroy, D. (2011). Are Visual Cue Masking and Removal Techniques Equivalent for Studying Perceptual Skills in Sport? *Perception, 40,* 474-489.

Memmert, D., Simons, D. J., & Grimme, T. (2009). The relationship between visual attention and expertise in sports. *Psychology of Sport and Exercise, 10,* 146-151.

Moran, A., Byrne, A., & McGlade, N. (2002). The effect of anxiety and strategic planning on visual search behaviour. *Journal of Sports Sciences, 20,* 225-236.

Moreno, F. J., Reina, R., Luis, V., & Sabido, R. (2002). Visual search strategies in experienced and inexperienced gymnastic coaches. *Perceptual and Motor Skills, 95,* 901-902.

Motter, B. C., & Belky, E. J. (1998). The guidance of eye movement during active visual search. *Vision Research, 38,* 1805-1815.

Nevalainen, S., & Sajaniemi, J. (2004). *Comparison of three eye tracking devices in psychology of programming research.* In E. Dunican & T.R.G Green (Eds). Proc. PPIG 16.

Omodei, M. M., McLennan, J., & Whitford, P. (1998). Using a head mounted video camera and two-stage replay to enhance orienteering performance. *International Journal of Sport Psychology, 29,* 115-131.

Page, J., Lafferty, M., & Wheeler, T. (2007). *An Exploration of Visual Search Between Coaches and judges in Gymnastics.* Unpublished, University of Chester.

Page, J.L. (2009). The development and effectiveness of perceptual training programme for coaches and judges in gymnastics. Unpublished Thesis: University of Chester.

Panchuk, D., & Vickers, J. N. (2006). Gaze Behaviours of Goaltenders under Spatial-Temporal Constraints. *Human Movement Science, 25 (6),* 733-752.

Panchuk, D ., & Vickers, J. N. (2011). Effect of narrowing the base of support on the gait, gaze and quiet eye of elite ballet dancers and controls. *Cognitive Process, 12,* 267-276.

Paull, G. C., & Glencross, D. J. (1997). Expert perception and decision making in baseball. *International Journal of Sport Psychology, 28, 35-56.*

Plessner, H., & Betsch, T. (2001). Sequential effects in important referee decisions: The case of penalties in soccer. *Journal of Sport and Exercise Psychology, 23,* 254-259.

Plessner, H., & Haar, T. (2006). Sports performance judgements from a social cognitive perspective. *Psychology of Sport and Exercise, 7,* 555-575.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124,* 372-422.

Rayner, K. (2009). Eye movements and attention in reading, scene perception, and visual search. *The Quarterly Journal of Experimental Psychology, 62(8),* 1457-1506.

Rayner, K., Liversedge, S. P., White, S. J., & Vergilino-Perez, D. (2003). Reading Disappearing Text: cognitive control of eye movements. *American Psychological Society, 14(4),* 385-388.

Ripoll, H., Kerlirzin, Y., Stein, J. F., & Reine, B. (1995). Analysis of information processing, decision making, and visual strategies in complex problem solving sport situations. *Human Movement Science, 14(3),* 325-349.

Salmela, J. H., Draper, S., & Laplante, D. (1993). *Development of expert coaches of team sports.* In S. Serpa, J. Alves, V. Ferreira, & A. Paul-Brito (Eds.), Sport Psychology: An integrated approach (pp. 296-300). Lisbon, Portugal: FMH.

Savelsbergh, G. J. P., Williams, A. M., Van Der Kamp, J., & Ward, P. (2005). Anticipation and visual search behaviour in expert soccer goalkeepers. *Ergonomics, 48,* 1686-1697.

Savelsbergh, G. J. P., Williams, A. M., Van Der Kamp, J., & Ward, P. (2002). Visual search, anticipation and expertise in soccer goalkeepers. *Journal of Sports Sciences, 20,* 279-287.

Sperling, G., & Weichselgartner, J. (1995). Episodic theory of the dynamics of spatial attention. *Psychological Review, 102,* 503-532.

Starkes, J. L., Helsen, W., & Jack, R. (2001). *Expert performance in sport and dance.* In R. Singer, H. A. Hausenblas, & C. M. Janelle (Eds.). Handbook of Sport Psychology (2^{nd} Ed., pp. 174-194). New York: Wiley & Sons.

Stefani, R. (1998). *Prediciting outcomes.* In J. Bennett (Ed.). Statistics in Sport (pp. 249-275). London: Arnold.

Ste-Marie, D. M. (1998). Expert-novice differences in gymnastic judging: An information-processing perspective. *Applied Cognitive Psychology, 13(3),* 269-281.

Ste-Marie, D. (2000). Expertise in Women's gymnastic judging: An observational approach. *Perceptual and Motor Skills, 90, 543-546.*

Ste-Marie, D. (2003). In expert performance in sports: Advances in research on sport expertise. J. L. Starkes, & K. A. Ericson (Eds.). USA: Human Kinetics.

Ste-Marie, D. M., & Lee, T. D. (1991). Prior processing effects on gymnastic judging. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 17(1),* 126-136.

Straub, W. F., & Williams, J. M. (1984). *Cognitive Sport Psychology.* Lansing, MI: Sport Science.

Tenenbaum, G. (2003). *Expert athletes: An Integrated approach to decision making.* In J. L. Starkes, & K. A. Ericsson (Eds.), *Expert Performance in Sports* (pp. 191-218). Champaign, IL: Human Kinetics.

Tenenbaum, G., & Bar-Eli, M. (1993). *Decision making in sport: A cognitive perspective*. In R. Singer, M. Murphy, & K. Tennant (Eds.), Handbook of research on sport psychology (pp.171-192). New York: Macmillan.

Tenenbaum, G., & Bar-eli, M. (1995). *Personality & intellectual capabilities in sport psychology.* In D. H. Saklofske, & M. Zeidner (Eds.), International handbook of personality & intelligence (pp. 687-710). New York: Plenum Press.

Treisman, A. (1982). Perceptual grouping and attention in visual search for features and for objects. *Journal of Experimental Psychology: Human Perception and Performance, 81,* 194-214.

Vaeyens, R., Lenoir, M., Williams, A. M., Mazyn, L., & Philippaerts, R. M. (2007). The effects of task constraints on visual search behaviour and decision making skill in youth soccer players. *Journal of Sport and Exercise Psychology, 29,* 147-169.

Vealey, R.S. (1988). Future directions in psychological skills training. The Sport Psychologist, 2, 318-336.

Vickers, J. N. (1992). Gaze control in putting. *Perception, 21,* 117-132.

Williams, A. M. (2001). *Perceptual expertise in sport: Some myths & realities.* In A. Papaionnou, M. Goudas, & Y. Theodrakis (Eds.), Proceedings of the 10th world congress of sport psychology, vol. 38 (pp. 206-211). Greece: Christodoulidi Publications.

Williams, A. M., & Davids, K. (1998). Visual search strategy, selective attention, and expertise in soccer. *Research Quarterly for Exercise and Sport, 69(2),* 111-128.

Williams, A. M., Davids, K., Burwitz, L., & Williams, J. G. (1992). Perception and action in sport. *Journal of Human Movement Studies, 22, 147-204.*

Williams, A. M., Davids, K., Burwitz, L., & Williams, J. G. (1994). Visual Search Strategies in Experienced and Inexperienced Soccer Players. *Research Quarterly for Exercise and Sport, 65(2),* 127-135.

Williams, A. M., Davids, K., & Williams, J. G. (1999). *Visual Perception and Action in Sport.* London: E & FN Spon.

Williams, A. M., & Elliott, D. (1999). Anxiety, expertise, and visual search strategy in karate. *Journal of Sport and Exercise Psychology, 21,* 362-375.

Williams, A. M., & Grant, A. (1999). Training perceptual skill in sport. *International Journal of Sport Psychology, 30 (2),* 194-220.

Williams, A. M., Janelle, C. M., & Davids, K. (2004). Constraints on the search for visual information in sport. *International Journal of Sport and Exercise Psychology, 2,* 301-318.

Wolfe, J. M. (2002). Visual Search. Originally Published in Attention, H. Pashler (Ed.), London, UK: University College London Press, 1998.

Wolfe, J. M. (2003). Moving towards solutions to some enduring controversies in visual search. *TRENDS in Cognitive Sciences, 7 (2).* 70-76.

Wolfe, J. M., Butcher, S. J., Lee, C., & Hyle, M. (2003). Changing your mind: On the contributions of top-down and bottom-up guidance in visual search for feature singletons. *Journal of Experimental Psychology: Human Perception and Performance, 29 (2),* 483-502.

Wolfe, J. M., Cave, K. R., & Franzel, S. L. (1989). Guided search: An alternative to the feature integration model for visual search. *Journal of Experimental Psychology: Human Perception and Performance, 15(3),* 419-433.

Wollman, N. (1986). Research on imagery and motor performance: Three methodological suggestions. *Journal of Sport Psychology, 8,* 135-138.

Wu, Y., Zeng, Y., Zhang, L., Wang, S., Wang, D., Tan, X., Zhu, X., Zhang, J., & Zhang, J. (2013). The role of visual perception in action anticipation in basketball athletes. *Neuroscience, 237,* 29-41.

8. Appendices:

8.1. Appendix One: Consent Form.

PARTICIPANT CONSENT FORM

Visual Search Scan Paths

Name of Researcher: …………………………. (University of Chester)

Supervisor of Researcher: ……………………. (University of Chester)

Please initial box

1. I confirm that I have read and understand the information sheet dated ………. for the above study and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my care or legal rights being affected. ☐

3. I understand that sections of any of my comments, which shall be audio-recorded if I give my permission, may be looked at by responsible individuals from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to use my comments in the ways stated on the accompanying 'Participant Information Sheet'. ☐

4. I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Name of Person taking consent (if different from researcher)	Date	Signature
Researcher	Date	Signature

8.2. Appendix Two: Health Questionnaire.

Health Questionnaire

Name: ______________________________

Date of Birth: _____________

In general, are you in good health? Yes/No
If not, please explain:

1. Are you at present taking ANY form of medication? Yes/No
   If YES please give brief details:

2. Do you suffer from epilepsy? Yes/No

3. If yes, please give details on the severity of your epilepsy and any medication that is prescribed to you:

4. Do you, or have you ever suffered from migraines? Yes/No

5. If yes, please provide details on the severity of the migraines, any medication that is taken, and how often they can occur:

6. Finally, is there anything to your knowledge that may prevent you from participating in the testing? Yes/No

Signed (participant) ______________________________ Date______________

Signed (Researcher) ___________________________ Date______________

8.3. Appendix Three: Participants Letter.

Donna Skyrme
Department of Sport & Exercise Sciences
University of Chester
Parkgate Road
Chester
CH1 4BJ
Email: @chester.ac.uk

September, 2008.

Dear Sir/Madam,

I am currently conducting a study for my MSc dissertation which explores the visual scan patterns of where and what elite riders and judges are looking at and if there are similarities or differences in these scan patterns. I would really appreciate your involvement in this research if it is at all possible? In short, I would like to conduct my research in the sport psychology laboratory situated at the University of Chester, ideally, during September 2008. There will be only one session that you would be required to attend and the testing would take no longer than 35-45 minutes. The study will adhere to conventional ethical standards of confidentiality and, as such, you will not be identifiable in the final report. If you would be at all interested in the research findings of this study once completed I would be more than happy to send you a brief summary of the main findings.

I genuinely hope you will be able to participate in the research and I look forward to hearing from you soon. If you are able to participate in the study, please feel free to contact me via email or, alternatively, using the tear-off slip and enclosed envelope to indicate whether you are able to help out on this occasion.

Yours sincerely,

Donna Skyrme

Research Supervisor:
Dr. Moira Lafferty (C.Psychol.)
Department of Sport & Exercise Sciences,
University of Chester.
Tel: 01244 513438
Email: m.lafferty@chester.ac.uk

I ………………………………………… of British Dressage are able/unable (delete as appropriate) to participate in your study at the University of Chester during September 2008.

I can be contacted by ……………(telephone) or …………………………(email)

Thanks for your time and for replying. Please return this slip by using the enclosed envelope.

Donna Skyrme
Department of Sport & Exercise Sciences.

8.4. Appendix Four: Participants Information Sheet.

Participant Information Sheet

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

What is the purpose of the study?
The purpose of this study is to explore the visual scan patterns of elite riders and elite judges in the sport of dressage to see if there are any differences in what the two groups are looking at when judging a dressage routine. This will allow for investigations into where and what elite riders and judges are looking and if there are similarities or differences between these two elite groups. Previous research in visual search has compared elite against novice and found significant differences, however research has not yet compared two elite groups within the same subjectively judged sport, therefore this study will allow for a new area to be investigated.

Why have I been chosen?
You have been chosen because you are either an elite dressage rider or an elite dressage judge that has been involved at regional and/or national level.

Do I have to take part?
It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect your rights in any way.

What will happen to me if I take part?

If you decide to take part, you will be given this information sheet to keep and asked to sign the consent form. You will also have to complete a health questionnaire as video footage is involved in the testing and anyone suffering from epilepsy must be informed. After you have given informed consent and filled out the health questionnaire you will take part in the study. You will watch three dressage tests twice whilst wearing an eye tracker, as shown in the picture. You will score the tests as normal complete with comments. You will then review each test for a second time and explain why you gave the score. The testing will last no longer than 35-45 minutes. You will be de-briefed after the testing is complete and if you wish to have a copy of the results on completion of the study then they will be sent to you.

What are the possible disadvantages and risks of taking part?
There may be some discomfort as you have to sit still for 20 minutes, however, a comfortable and supportive chair will be provided to reduce the discomfort as much as possible.

What are the possible benefits of taking part?
This research will begin to examine if differences exist between judges and riders and therefore may be useful for training purposes.

What if something goes wrong?
If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, please contact Prof. Sarah Andrew, University of Chester, Parkgate Road, Chester, CH1 4BJ.

If you are harmed by taking part in this research project, there are no special compensation arrangements. If you are harmed due to someone's negligence (but not otherwise), then you may have grounds for legal action, but you may have to pay for this.

Will my taking part in the study be kept confidential?
All information which is collected about you during the course of the research will be kept strictly confidential so that only the researcher, supervisor and external examiner will have access to such information.

What will happen to the results of the research study?
The results will be written up into a student dissertation and, possibly, a research paper that will be submitted to an academic peer-reviewed journal. Individuals who participate will not be identified in any subsequent report or publication.

Who is organising and funding the research?
The research is organised and conducted by a student of the Department of Sport and Exercise Sciences at the University of Chester

Who may I contact for further information?
If you would like more information about the research before you decide whether or not you would be willing to take part, please contact:

Name   Donna Skyrme
University E-mail: @chester.ac.uk

Thank you for your interest in this research.

8.5. Appendix Five: Novice Scoring Sheet.

1	A	Enter in working trot		Mark	Comment	Key Point from Discussion
	X C	Halt. Immobility. Salute. Proceed at working trot Turn right	Quality of the trot. Straightness on centre line. Evenness of contact Quality of turn at C			
2	R S V P FAKV	Turn right Turn left Turn left Turn right Working trot	Quality of trot, regularity & tempo Quality of turn at R Quality of turn at S Quality of turn at V Quality of turn at P			
3	V	Circle right 10 metres	Quality of trot, regularity & tempo Uniform bend along line of circle			
4	VM MC	Change rein & show some medium trot strides Working trot	Quality of trot, regularity & tempo. Ground cover swing through back Working from behind			
5	C	Halt immobility 4seconds	Fluency, balance and thoroughness of transition Balance and relaxation in halt			
6	C CH	Rein back 3-4 steps (one horses length) Medium walk	Steps straight in diagonals and clearly defined. Self carriage, fluency Regularity, purpose, relaxation, freedom			
7	HP	Change the rein in free walk on a long rein	Regularity, purpose, stretching forward and down, ground cover & suppleness of whole body			
8	PK KA	Change the rein in medium walk Medium walk	 Regularity, purpose, relaxation & freedom			
9	A AP	Working trot Working trot	Fluency, balance & thoroughness of transition Quality of trot			
10	P	Circle left 10 metres diameter	Quality of trot, regularity & tempo. Uniform bend along line of circle			
11	PH H	Change rein & show some medium trot strides Working trot	Quality of trot, regularity & tempo. Ground cover swing through back Working from behind			
12	C MBF F	Working canter right Show some medium canter strides Working canter	Fluency, balance & thoroughness of transition Quality of canter, regularity & tempo Ground cover. Relative straightness			
13	A	Circle right 20 metres diameter	Quality of canter, regularity & tempo. Uniform bend along line of circle			
14	KLB	Change rein, give and retake reins over centre line	Quality of canter, regularity & tempo. Give and retake reins			
15	BRM M	Counter canter Working trot	Quality of canter. Balance. Straightness. Positioning in counter canter. Fluency, balance, thoroughness of transition. Quality of trot			
16	C	Working cater left & circle left 20 metres diameter	Fluency, balance, thoroughness of transition. Quality of canter, regularity & tempo. Uniform bend along line of circle			
17	HIB	Change rein, Give and retake the reins over the centre line	Quality of canter, regularity & tempo. Give and retake the reins			
18	BPF F	Counter canter Working trot	Quality of the canter. Balance. Straightness. Positioning in counter canter. Fluency, balance & thoroughness of transition. Quality of trot			
19	A X	Down the centre line Halt immobility, salute	Quality of trot, balance in turn. Straightness. Fluency & thoroughness of transition Balance & relaxation in halt			

Collectives:

20.	Paces	Freedom and regularity	
21.	Impulsion	Desire to move forward, elasticity of steps, suppleness of the back, engagement of hind quarters	
22.	Submission	Attention and confidence, harmony, lightness and ease of the movements, acceptance of the bridle, lightness of the forehand	
23.	Rider	Riders position and sear, correctness and effect of the aids	

8.6. Appendix Six: Raw Data (attached CD).